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International Petroleum Encyclopedia

1991

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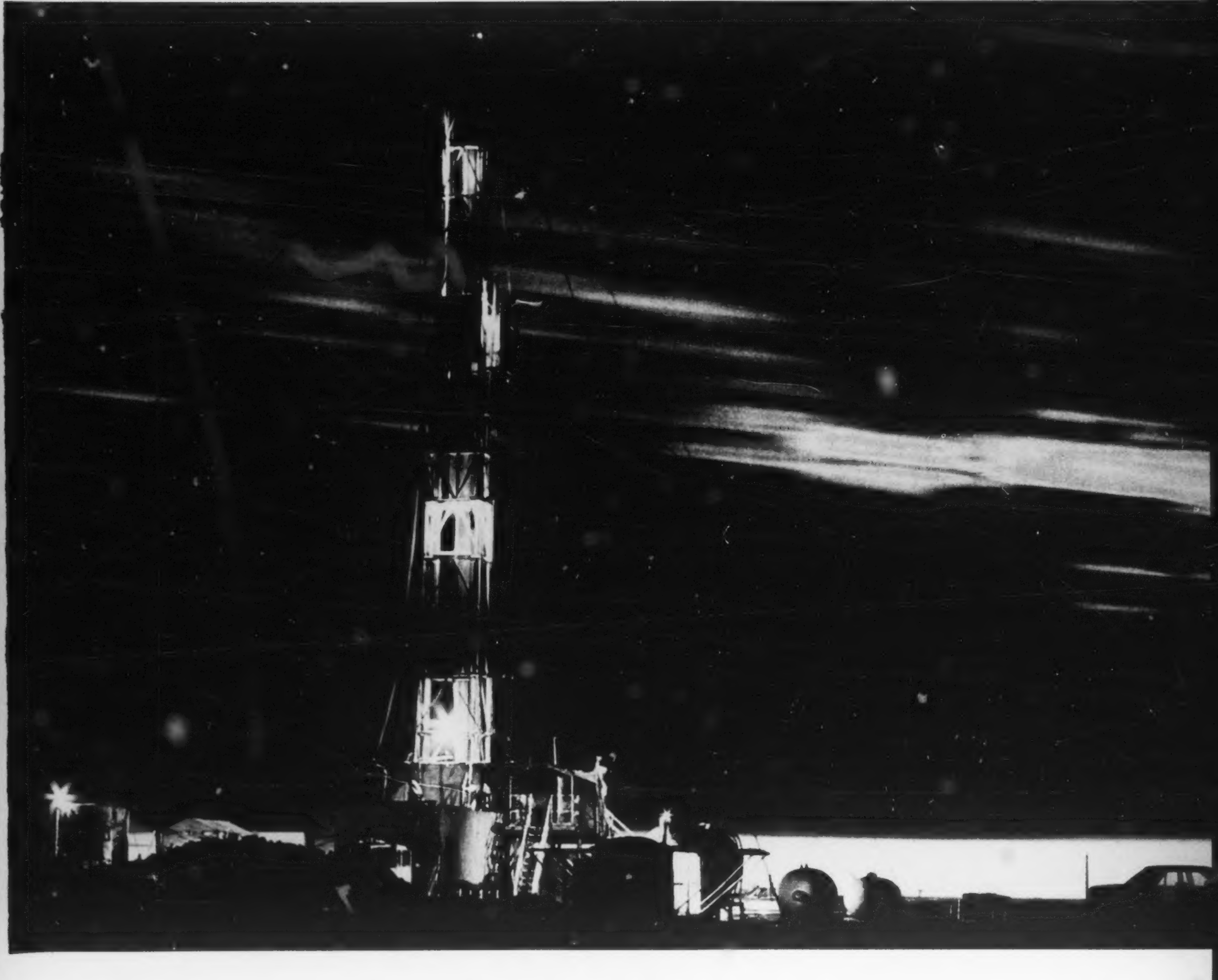

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INTERNATIONAL PETROLEUM ENCYCLOPEDIA

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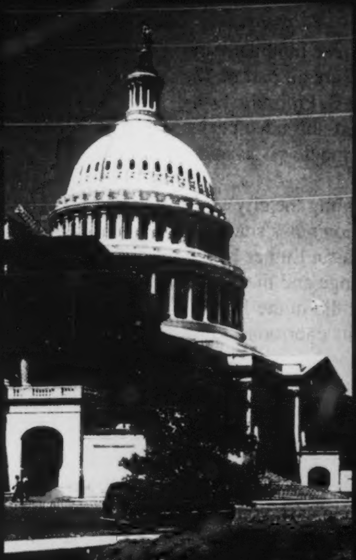

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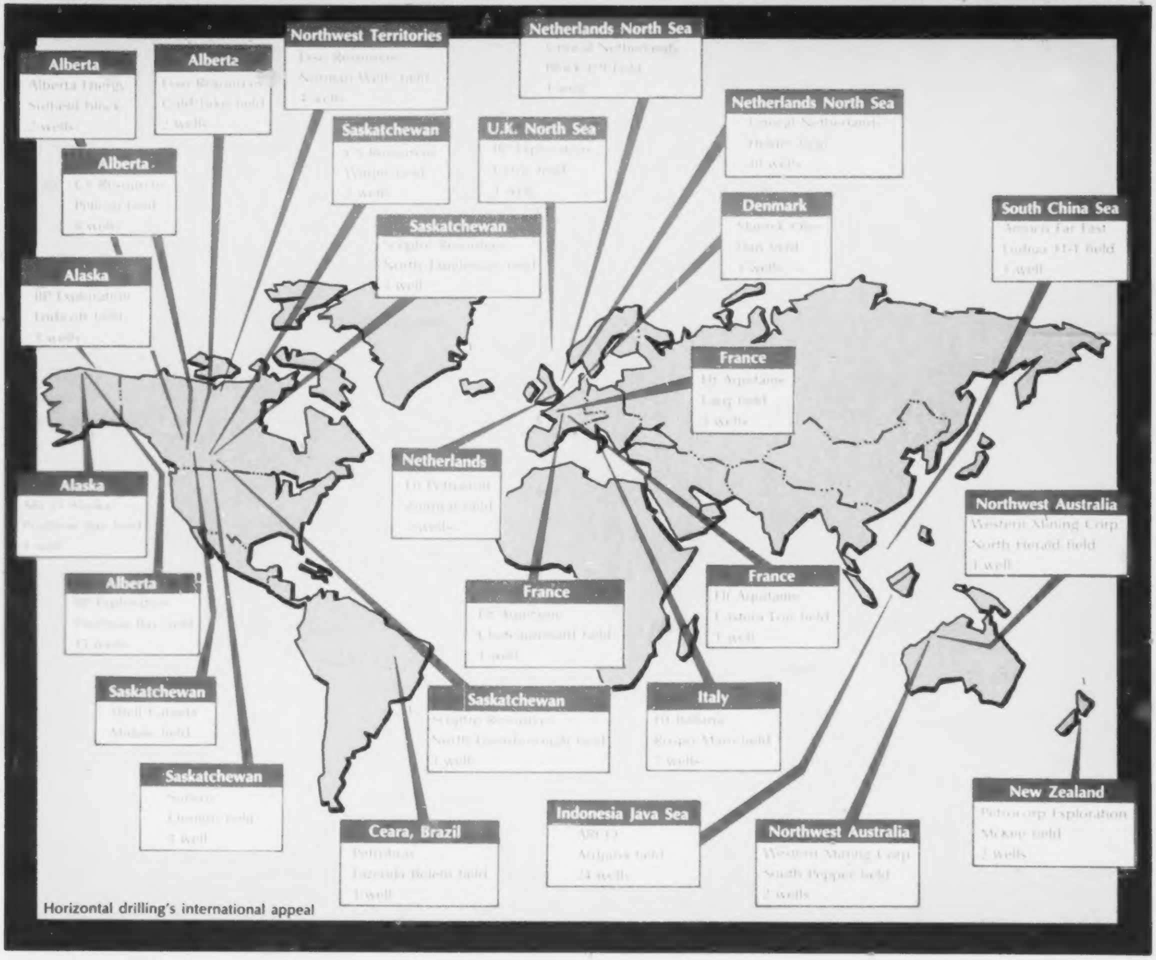
How international horizontal drilling has blossomed

Fig. 1


Alberta
Alberta Energy
2 wells
Alberta
Alberta
Northwest Territories
Netherlands North Sea
Saskatchewan
U.K. North Sea
Netherlands North Sea
Saskatchewan
Denmark
South China Sea
Amoco Far East
Liuhua 11-1 field
1 well
Alaska
BP Exploration
Endicott field
3 wells
France
Elf Aquitaine
Netherlands
Northwest Australia
Western Mining Corp.
North Herald field
1 well
Alaska
Alberta
France
France
Elf Aquitaine
1 well
Saskatchewan
Saskatchewan
Italy
Saskatchewan
Indonesia Java Sea
24 wells
Northwest Australia
Western Mining Corp.
South Pepper field
2 wells
New Zealand
Petrocorp Exploration
McKee field
2 wells
Ceara, Brazil
Petrobras
1 well

Horizontal drilling's international appeal

December 1990 it was within five wells of reaching the revised goal.

Drilling time was 40 days/well with an average lateral length of more than 3,000 ft.

Drilling costs were about $1.2 million/well, but the cost per foot of the lateral portion had dropped 25% since the start of the program.

Oryx placed its average lifting cost at $1.56/BOE, but by late 1990 lifting costs had fallen to $1.38/BOE since January 1990. Oryx placed combined finding, development, and acquisition costs at about $3/BOE.

The company's cumulative production from all its Pearsall field horizontal wells was nearly 3 million bbl, including nearly 400,000 bbl from 1 Heitz, the well with the greatest cumulative production.

Oryx's gross production from all its Pearsall field horizontal wells was more than 22,000 b/d of oil and 12 MMcfd of gas. Net production was about 80% of gross production.

The gross production figure was 2.3 times what it was in January 1990.

The company operated more than 170 Austin chalk wells, including 12 horizontal wildcats and 43 horizontal development wells. The other 115 were vertical wells.

Oryx's success ratio was better than 70% for exploratory Austin chalk wells and more than 90% for development wells.

Gross reserves averaged 450,000 bbl of oil and 225 MMcf of gas, or a combined 488,000 BOE/well.

Through September 1990 Oryx had booked 68 million net equivalent bbl of proved reserve additions.

All but five of Oryx's horizontal Austin chalk wells were economic successes, and none was a dry hole.

Oryx simulations show that its Austin chalk horizontal wells may produce two thirds of estimated ultimate recovery in the first 2 years of production and have ultimate economic lives of 15-20 years.

UPRC building up Austin chalk program

UPRC operated 57 horizontal wells on production and participated in 13 nonoperated horizontal producing wells by yearend 1990.

Its Austin chalk oil equivalent production was a gross 24,400 b/d and net 14,700 b/d.

Through mid-October 1990 UPRC estimated average gross reserves for its Austin chalk horizontal wells at

Pearsall field drainage efficiency

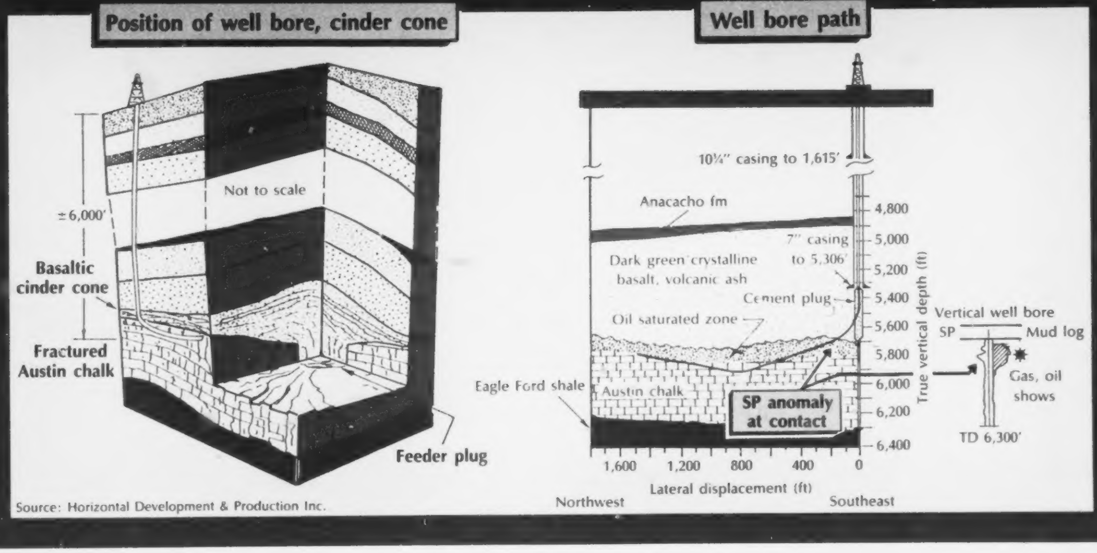
Table 1

Well	Lateral chalk exposure ft	Assigned proration unit size acres	Estimated OOIP st-tk bbl/acre ft	Estimated net pay thickness ft	Estimated OOIP 1,000 st-tk bbl	Estimated ultimate oil recovery	
						1,000 st-tk bbl	% OOIP
9 John B. Baggett	950	160	76.6	176	2,157.8	430.7	20.0
13 John B. Baggett	2,255	280	76.6	173	3,719.0	359.9	9.7
3 E.B. Jones B	2,327	280	76.6	179	3,849.9	534.0	13.9
2 Stroman Harris	4,043	384.57	77.9	144	4,325.5	753.1	17.4
11 Panther Hollow	1,709	240	85.5	141	2,897.2	198.3	6.8
1 J.R. Avant	2,623	320	84.9	129	3,506.7	231.1	6.6
9 Frank Bracewell	2,323	280	76.7	97	2,089.6	144.6	6.9
					22,545.7	**2651.7**	**11.8**

Source: Oryx Energy Co.

Two views of the HDP Inc. 1 Autumn Unit

Fig. 4



Position of well bore, cinder cone

Well bore path

Not to scale
±6,000'
Basaltic cinder cone
Fractured Austin chalk
Feeder plug
10¾" casing to 1,615'
Anacacho fm
7" casing to 5,306'
Dark green crystalline basalt, volcanic ash
Cement plug
Oil saturated zone
Eagle Ford shale
Austin chalk
SP anomaly at contact
4,800
5,000
5,200
5,400
5,600
5,800
6,000
6,200
6,400
True vertical depth (ft)
Vertical well bore
SP
Mud log
Gas, oil shows
TD 6,300'
1,600
1,200
800
400
0
Lateral displacement (ft)
Northwest
Southeast

Source: Horizontal Development & Production Inc.

volcanic mounds. The well bore of the 1 Autumn Unit entered the chalk about 500 ft from the south end of the volcanic plug.

The well was drilled on a farmout from American Exploration Co., Houston.

Meanwhile, ARCO Oil & Gas Co. signed an agreement in early 1990 with Petro-Hunt Corp., Dallas, to pursue Austin chalk development on about 50,000 acres in Wilson and Gonzales counties, Tex.

The companies hoped to drill eight to 12 wells during the year.

And Paramount Petroleum Co. Inc., Houston, had acquired more than 30,000 acres by mid-1990 in Gonzales, Wilson, and Karnes counties and was seeking partners for an Austin chalk exploratory program.

Attention to detail important in the chalk

The performance of Austin chalk horizontal wells is not evenly distributed.

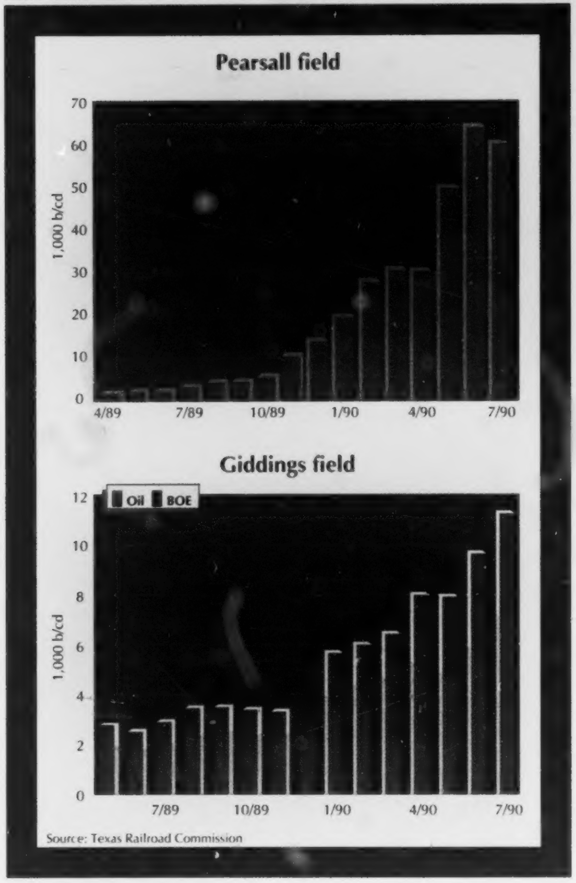
The data that lead to that conclusion are skewed by the concentration of horizontal wells in the more heavily developed portions of Pearsall field, particularly in Frio County, and operator competence, said Petrie Parkman & Co., Denver investment consulting firm.

The degree of Austin chalk horizontal drilling success appeared to be operator specific and correlated with the degree of technical sophistication employed in all phases of the project: wellsite selection, drilling, completion, and reservoir management producing operations.

Individual horizontal well performance in Pearsall and Giddings fields (Fig. 5) was heavily influenced by:

- Reservoir depletion by vertical wells and/or offsetting horizontal wells.
- Placement of the horizontal well bore relative to fracture orientation.
- The number and geometry of macrofractures intersected by the horizontal well bore.
- Length of the completed interval within specific zones containing a high proportion of clean or brittle chalk.

Austin chalk horizontal well production



Pearsall field

Giddings field

Source: Texas Railroad Commission

East Texas, Louisiana chalk action picks up

East Texas and North Louisiana in 1990 began to see horizontal exploration in Austin chalk, Cretaceous Saratoga chalk, and Eocene Wilcox.

Maersk Energy Co., Houston, completed 1 ARCO in Brookeland field of southern Sabine County, Tex., flowing 711 b/d of 43.6° gravity oil, 2.061 MMcfd of gas, and 556 b/d of water from Austin chalk open hole at 8,904-84 ft.

The well, 13 miles south-southeast of Hemphill, was 150 miles northeast of the nearest horizontal Austin chalk well in Brazos County.

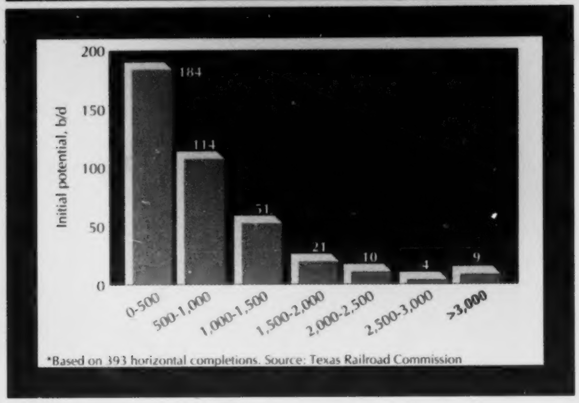
ARCO, which owned a royalty interest in the well, held a large amount of fee acreage in the area and was said to be planning horizontal drilling there.

Maxwell Oil & Gas Co., Kilgore, completed 1 Hawkeye in Center field of Shelby County in late 1990.

It pumped 80 b/d of 43° gravity oil with a trace of water and 16 Mcfd of gas from Cretaceous Saratoga chalk at 2,210-60 ft measured depth (MD) in the curved portion of the well bore. TVD was 2,190 ft.

Saratoga Resources, Houston, in early 1991 planned to drill 110 Temple-Eastex, a horizontal Saratoga chalk test in Hemphill field of Sabine County. It was to be a short radius test with a proposed horizontal displacement of 200-300 ft at TVD 6,000 ft.

Pearsall field initial potentials*



*Based on 393 horizontal completions. Source: Texas Railroad Commission

OXY U.S.A. Inc., Houston, which operated nearly one third of the 200 vertical producing wells in Olla field of LaSalle Parish, La., was planning more horizontal development in the region in 1991.

The company in late 1990 completed a horizontal well producing oil from the Cruse sand member of Eocene Wilcox. The test was the first horizontal well drilled in the North Louisiana basin.

OXY's 13-1 Tremont H produced 605 b/d of oil and no formation water on a submersible pump from an approximately 300 ft section in the Cruse F-1/Reservoir B sand at 2,310 ft TVD, 3,243-3,542 ft MD. The field is about 40 miles south of Monroe, La.

A typical vertical Cruse sand well in the field produced 50-100 b/d of oil. OXY said the horizontal well was intended to improve recovery and reduce water encroachment.

Wolfe & Magee Inc. and JWR Exploration Inc. completed 1 Sonat Minerals B-5 in Pendleton-Many field of Sabine Parish, La. Saratoga chalk at about 2,320 ft TVD flowed 104 b/d of 41.4° gravity oil and 15 Mcfd of gas but later began producing mostly water.

Late in the year, Oryx staked 1 Sonat Minerals, a Saratoga chalk test in Fort Jessup field about 5 miles southeast of the Pendleton-Many field well.

Smackover target in Alabama, Arkansas

Alabama and Arkansas operators tried horizontal drilling to Jurassic Smackover limestone, with the Alabama well setting a depth record for horizontal wells.

And Mississippi got its first two horizontal completions producing oil from Eocene Wilcox.

Smackco Ltd., Brewton, Ala., set the depth record in deepening a former vertical well in Huxford field, Escambia County (Fig. 7).

Its 1 Cruit 26-15 flowed 300 b/d of oil and 475 Mcfd of gas through a $^{13}/_{64}$ in. choke with 1,350 psi flowing tubing pressure.

The well reached horizontal at 14,936 ft TVD, surpassing the previous world record of 11,484 ft set at a North Dakota well.

After reaching horizontal, the well continued to build and hold angle of about 100° for a length of 405 ft in Smackover.

The well is a recompletion of Smackco's 2 ATIC 35-2, which produced more than 250,000 bbl of oil before water encroached. Using medium radius lateral drilling, Smackco displaced the bottom of the hole about 800 ft from the old vertical well bore.

The horizontal leg cost about half the price of a new

One operator's Bakken learning curve*

Table 2

	Drilling/ completion costs $/BOE	Reserves BOE	Initial potential B/DOE	Finding and development cost $/BOE	After tax rate of return† %
First 10 wells	1.52	252,000	252	6.83	30.6
Second 10 wells	1.26	234,000	227	5.84	44.2
Third 10 wells	1.09	269,000	240	4.36	66.6
After 30 wells	1.29	241,000	240	5.77	43.3
After 50 wells	1.23	200,000	199	6.71	31.0

*Adapted from Meridian Oil Inc. †Based on $18/bbl wellhead netback.

Operators completed 67 horizontal wells for the record during 1990. Of those, 48 were oil and gas wells, nine were shut in awaiting further evaluation, and 10 were either abandoned or temporarily abandoned. Most of the unsuccessful or noncommercial wells were in Dunn and Mountrail counties.

Ash Coulee field in Billings County was one of the sweet spots being developed with horizontal wells, with at least nine Bakken wells completed there during 1990, MOJ reported.

Initial potential at one well was reported as 1,900 b/d of oil, and another made more than 1,350 b/d. Early in the fourth quarter the average production for each Ash Coulee horizontal well was 107 b/d of oil and a trace of water. Two wells were flowing about 430 b/d of oil with no water.

Most active Ash Coulee field horizontal well operators were Slawson, Columbia, and Leede.

Meanwhile, Pennzoil Exploration & Production Co. in early 1991 was starting 26-13H Candee, in Richland County, Mont., the state's first horizontal well to target Mississippian Madison.

The company planned to evaluate the fractured, porous Ratcliff reservoir and a fractured limestone in Mission Canyon on the north side of Ridgelawn field. Projected depths were 12,350 ft MD, 9,350 ft TVD.

On the Bearpaw arch in Blaine County, North Central Montana, Texaco completed two horizontal oil wells in Bowes-Sawtooth Unit from the Bowes member of the Piper formation (Jurassic Sawtooth).

The A502 Bowes-Sawtooth Unit pumped 127 b/d of 18° gravity oil and 54 b/d of water from Sawtooth perforations at 3,617-5,620 ft MD. The 1,500 ft horizontal segment of the hole entered Sawtooth at 3,485 ft TVD.

The D806 Bowes-Sawtooth Unit, 2 miles east of the first well, pumped 83 b/d of 18.9° gravity oil and 71 b/d of water from perforations at 3,460-5,199 ft MD. Horizontal displacement was 1,557 ft.

Texaco in 1983 drilled six vertical infill wells in the unit that pumped 12-90 b/d of oil and 2-52 b/d of water.

Niobrara plays expand in Colorado, Wyoming

Exploitation of oil in fractured Cretaceous Niobrara limestone got a jump start in mid-1990 with completion of a well in Silo field in the Denver basin in Laramie County, Wyo. (Fig. 10).

Cowan Oil Co., Greeley, Colo., 1 Warren was completed in June flowing at the rate of 2,000 b/d of oil and 500 Mcfd of gas from Niobrara. The well had produced about 21,000 bbl of oil in its first 4 months on production, and pump rate had declined to about 50 b/d.

UPRC plugged 1 Lazy D 21-3, in Weld County, Colo., its first Niobrara horizontal test. The well was delayed by many mechanical problems involving drilling and testing. It apparently found very few open, natural fractures in Niobrara and recovered oil at noncommercial rates from a 2,000 ft open hole interval, Petroleum Information reported.

Later in the year UPRC's 1H Antelope 9-11 in Silo field flowed at a rate of 1,462 b/d of oil on a 21 hr test through a 44/64 in. choke with 225 psi flowing tubing pressure.

Horizontal displacement was 2,529 ft, of which 2,037 ft were within Niobrara.

Snyder Oil Corp., Fort Worth, completed its first Silo field well, 2H Willett, pumping at a rate of 216 b/d of oil, but later production and pressure tests were disappointing. At year-end the company was planning to stimulate the well.

It was also spudding a second well, 10-21H Hutton.

About 30 miles southeast of Silo field, Snyder staked 20-3H Burbach, a horizontal Niobrara wildcat 1 mile southeast of Hereford field in Weld County, Colo. Location was 24 miles east of a Weld County wildcat UPRC plugged in 1990 after recovering noncommercial volumes of oil from a horizontal Niobrara section.

Westoil Production Co., Denver, staked two horizontal Niobrara wells in Wellington field, Larimer County, Colo.

The 1 Thompson 4-7H was to have a 1,440 ft horizontal section at 4,100 ft TVD in a N. 15° W. direction from the vertical portion of the hole.

Site was about 1½ miles south of a vertical well that produced about 42,000 bbl of oil from Niobrara in the late 1920s.

Westoil also planned 1 Box I4-30H, in 30-10n-68w, about 3 miles north of the first well.

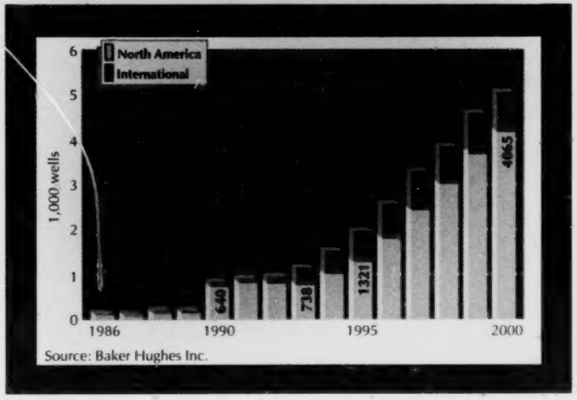
The two wells were part of an eight well horizontal drilling program Westoil planned on its 35,000 acre Front Range leasehold in Northeast Colorado and Southeast Wyoming.

Other areas in which the company planned horizontal Niobrara tests were in Boulder field, Boulder County; Berthoud field, Larimer County; South Borie-Rawhide prospect, Larimer County; and Wyoming's Silo field.

Gerrity Oil & Gas Corp., Denver, also staked two horizontal Niobrara tests in Silo field.

Economics of the Niobrara appeared to be attractive at about $20/bbl if operators were able to establish reserves of about 125,000 bbl/horizontal well and completed well cost could be reduced to $1.2 million/well.

How horizontal drilling will grow



Source: Baker Hughes Inc.

system provided by Petrolphysics, were at angles of 90° or more to vertical.

After drilling, the laterals were lined with flexible sand barrier, a tube that served as a production conduit (Fig. 12).

Making each radial required 12-14 hr. Horizontal drilling contractor's cost was $30,000-40,000/radial.

Laterals averaged 40 ft in length at a reentry in the same section that was not as successful, Texaco said.

Texaco was evaluating results, believed the wells showed horizontal drilling is applicable in the area, believed costs could be reduced, and was considering further horizontal drilling in early 1991.

Drilling, completion concerns voiced

Here is a selection of technology concerns voiced by a horizontal drilling specialist:

Most of the early wells were drilled diagonally across target formations. Reservoir modeling clearly shows that there is an optimum elevation for most horizontal well applications.

With a slant hole, the portions that are too high and too low will have limited productivity. Eventually, all horizontal wells will be drilled at the optimum elevation. A noticeable shift in this direction is probably already started in the Austin chalk.

The critical keys required for a successful horizontal hole are the vertical continuity of the reservoir and the control of drilling and completion fluid damage. The completion technique can have a significant impact on these two parameters. The Austin chalk boom did not start until someone discovered that the incredibly damaging effect of dry drilling could be essentially eliminated by underbalanced drilling. The result, in August 1989, was the first Austin chalk well that potentialed for more than 1,000 b/d.

In the rest of the industry's horizontal testing efforts, the norm has been overbalanced drilling and slotted liner completions. This technique offers the worst possible way for obtaining vertical continuity and controlling damage.

Completions that utilize cemented strings and selective perforation and stimulation techniques offer the best methods for improving vertical continuity and eliminating damage effects. The number of aggressive completions is increasing but is still a small fraction of the total number drilled.

Gas applications slow but increasing

Horizontal drilling for gas was much slower in developing, and few resounding successes were reported outside Conoco's North Valliant test in the U.K. North Sea.

The U.S. Department of Energy was conducting an extensive research and field testing program on horizontally drilled wells in the Appalachian basin and publishing large volumes of data on planning, drilling, and testing of the resulting wells.

Early field results showed that horizontal wells can yield flow rates greater than vertical wells, drilling and completion costs are extremely high compared with vertical wells, and multiple frac jobs may be required to maximize production.

BDM Corp., McLean, Va., CNG Development Co., Pittsburgh, and DOE spudded West Virginia's third horizontal well and the first in Calhoun County late in 1990.

It was 3997 Hunter Bennett, 44 miles northwest of Charleston in Millstone quadrangle, Lee district. It was on a CNG lease in Russet field, which produces oil and gas from Mississippian Big Injun. The plan was to drill vertically to 2,810 ft, then kick off at about 2,000 ft and drill a 2,000 ft horizontal leg through Devonian Fifth sand.

The well was within 2 miles of Devonian gas production in three fields: Dekalb, Grantsville, and Yellow Creek.

Two horizontal wells were drilled in Wayne County, W.Va., in the mid-1980s.

Many companies see potential in horizontal gas drilling if gas prices improve.

For instance, National Fuel Gas Co. drilled and completed only one vertical development gas well in Northeast Clay field during fiscal 1990 because of low gas prices.

However, it planned to pursue further development of the acreage as gas prices rose and as it continued to evaluate the potential for horizontal drilling in the region.

Columbia Gas Development pointed out that one third of its extensive Appalachian acreage holdings have Devonian shale potential, and successful development of horizontal drilling techniques in the basin could add considerable value.

Oryx late in the year staked a horizontal test of Cretaceous Cozzette, a gas bearing horizon, in the Piceance basin in northeastern Mesa County, Colo.

Its 1 HD Acapulco-Federal was to be drilled to 11,700 ft MD and about 9,150 ft TVD. Location was about 6 miles west of Divide Creek field.

More spectacular growth: supportable?

Horizontal drilling's growth in the first few years of widespread commercial applications has been at the rate of several hundred percent per year.

Many forecasts are available. One, by Baker Hughes Inc., indicates that U.S. horizontal drilling will more than double to 1,321 wells in 1995, compared with 640 in 1990. In 2000 Baker Hughes expects horizontal drilling to reach 5,000 wells internationally, including 4,065 in the U.S.

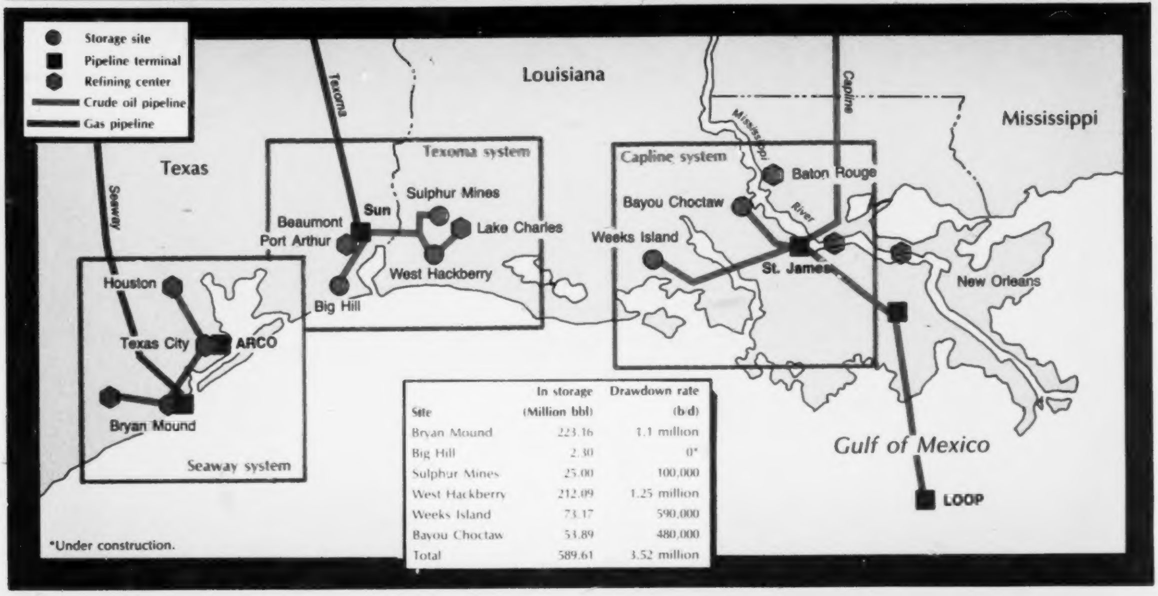
Such growth rates provided tremendous advantages, such as the application of a vast array of brainpower, and created enormous problems in hiring and training people and providing/maintaining equipment. One concern in medium radius drilling in the Austin chalk trend has been the supply of downhole motors. One large horizontal drilling service company increased its inventory of 4¾ in. motors to 110 in fourth quarter 1990 from 90 in the third quarter and said economics provided for no further increases.

Maurer Engineering Inc., Houston, had been conducting a joint industry Drilling Engineering Association project on horizontal drilling since 1987. About 104 companies from 19 countries joined the $3.5 million, 36 month first phase of the project.

The project was successful, resulting in distribution of 12 manuals and 10 computer programs on horizontal well technology.

Participants asked the engineering firm to follow up with a second phase project that started Dec. 1, 1990.

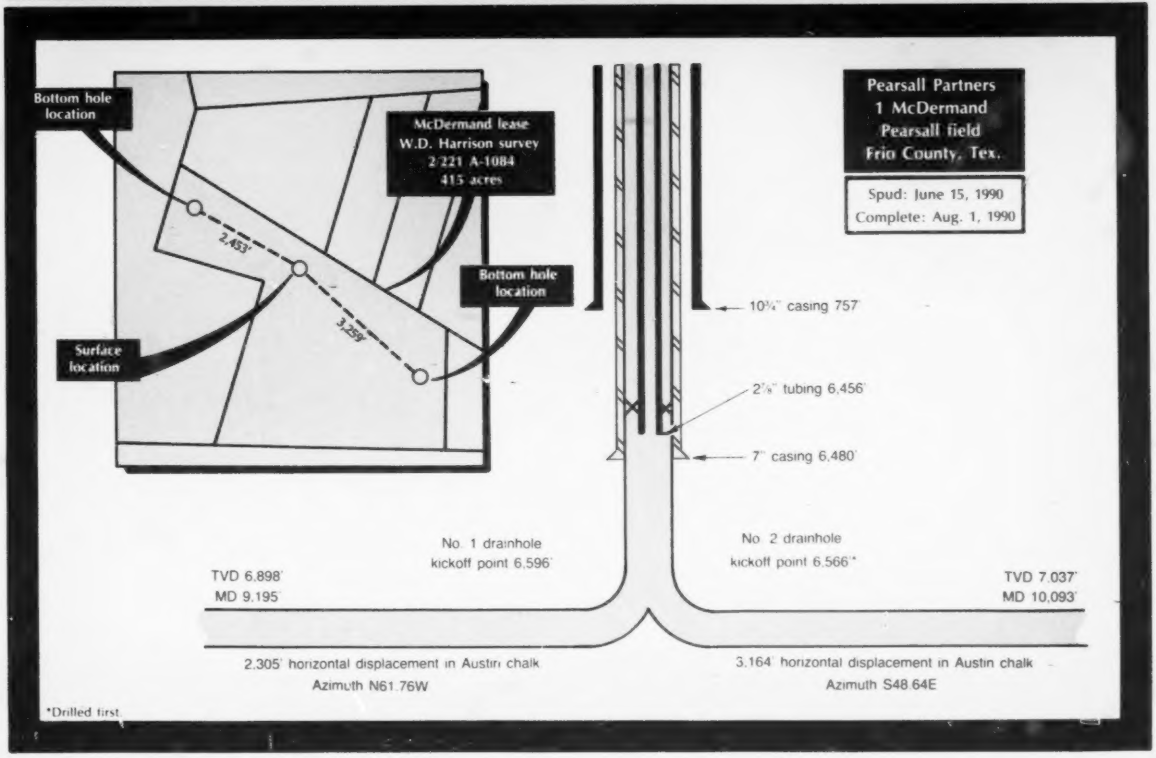
Where the U.S. SPR and related facilities are


Storage site
Pipeline terminal
Refining center
Crude oil pipeline
Gas pipeline
Louisiana
Mississippi
Texas
Texoma
Capline
Seaway
Mississippi River
Texoma system
Capline system
Seaway system
Sulphur Mines
Sun
Beaumont
Port Arthur
Lake Charles
West Hackberry
Big Hill
Houston
Texas City
ARCO
Bryan Mound
Baton Rouge
Bayou Choctaw
Weeks Island
St. James
New Orleans
Gulf of Mexico
LOOP

Site	In storage (Million bbl)	Drawdown rate (b/d)
Bryan Mound	223.16	1.1 million
Big Hill	2.30	0*
Sulphur Mines	25.00	100,000
West Hackberry	212.09	1.25 million
Weeks Island	73.17	590,000
Bayou Choctaw	53.89	480,000
Total	589.61	3.52 million

*Under construction.

Schematic of dual drainhole well


Bottom hole location
McDermand lease
W.D. Harrison survey
2/221 A-1084
415 acres
2,453'
3,259'
Bottom hole location
Surface location
Pearsall Partners
1 McDermand
Pearsall field
Frio County, Tex.
Spud: June 15, 1990
Complete: Aug. 1, 1990
10¾" casing 757'
2⅞" tubing 6,456'
7" casing 6,480'
No. 1 drainhole
kickoff point 6,596'
No. 2 drainhole
kickoff point 6,566'*
TVD 6,898'
MD 9,195'
TVD 7,037'
MD 10,093'
2,305' horizontal displacement in Austin chalk
Azimuth N61.76W
3,164' horizontal displacement in Austin chalk
Azimuth S48.64E

*Drilled first.

Table 1

1991 U.S. oil and gas supply/demand

	(1,000 b/d)	% change 1990-91
PETROLEUM		
DEMAND		
Motor gasoline	7,150	−1.5
Aviation fuels	1,543	1.8
Distillate fuel	3,105	0.2
Residual fuel oil	1,251	−3.2
All other	3,919	−0.2
Domestic demand	16,968	−0.7
Exports	782	−0.4
Total demand	17,750	−0.7
SUPPLY		
Production		
Crude oil	7,043	−2.5
Natural gas liquids	1,526	1.3
Total production	8,569	−1.9
IMPORTS		
Motor gasoline	413	−5.7
Aviation fuels	99	−6.6
Distillate fuel	301	−0.7
Residual fuel oil	531	−3.3
All other	793	−0.8
Total products	2,137	−2.6
Crude oil imports*	6,337	2.1
Total imports	8,474	0.9
Other supply†	702	−17.6
Total supply	17,745	−1.3
Change in stocks	−5	—
Refinery crude runs§	13,728	−1.1
ENDING STOCKS		**(Million bbl)**
Motor gasoline	222.5	3.1
Aviation fuels	44.1	−0.9
Distillate fuel	118.6	−4.0
Residual fuel oil	46.2	0.9
All other	268.8	1.4
Total products	700.2	0.8
Crude oil	339.9	−2.0
Total stocks	1,040.1	−0.2
Imports as % of domestic demand	49.9	—

	(bcf)	% change 1990-91
NATURAL GAS		
DISPOSITION		
Consumption		
Residential	4,625	4.2
Commercial	2,675	3.8
Industrial	6,910	1.9
Electric utilities	2,730	0.6
Total to consumers	16,940	2.6
Lease and plant fuel	1,190	0.2
Pipeline fuel	590	4.6
Total consumption	18,720	2.5
Exports	120	13.2
Additions to storage	2,375	1.5
Unaccounted for	330	40.4
Total disposition	21,545	2.9
SUPPLY		
Production (dry)	17,500	1.1
Imports	1,565	5.3
Withdrawals from storage	2,325	16.2
Supplemental gaseous fuels	155	0.6
Total supply	21,545	2.8
INVENTORY		
Base natural gas•	3,850	0.0
Working natural gas	2,900	1.8
Total inventory	6,750	0.7

*Excludes Strategic Petroleum Reserve. †Refinery processing gain, unaccounted crude oil, and other hydrocarbons. §Crude oil, natural gas liquids, unfinished oils, and other hydrocarbons. •The volume required for permanent inventory to maintain underground reservoir pressure and deliverability. √The volume above design level of base natural gas.

Source: Independent Petroleum Association of America supply/demand committee

"While the oil market is very tight with little spare capacity," he said, "there is sufficient oil to meet current needs. The oil market has simply not taken into account the additional production coming on stream from a variety of sources or available commercial stocks. There is no justification for the intensive, unwarranted speculation in oil futures."

DOE sent sale notices Sept. 28 to more than 300 U.S. refiners, traders, cooperatives, and state energy offices.

Although 5 million bbl was authorized for sale, 11 companies were high bidders for only 3.925 million bbl.

Average high bid prices ranged from $34.14/bbl for West Hackberry sour to $38.68 for Bayou Choctaw sweet. Including rejected offers, bids ranged from a low of $27.85 to a little more than $39.06.

Amoco Oil Co. was high bidder on the most oil, 1.12 million bbl.

The sale attracted 33 bidders with 40 offers totaling 10.4 million bbl.

DOE said no bids for one of the six types of crude offered resulted in a little less than 4 million bbl being sold.

It said the lack of bids for sour crude from the SPR's Weeks Island site southwest of New Orleans was most likely the result of an increase in the flow of Alaskan North Slope crude oil to the Gulf Coast expected in November. DOE had offered 800,000 bbl of sour crude from Weeks Island.

The last 250,000 bbl of the test sale was delivered Dec. 2 to Phibro Energy Inc., Greenwich, Conn.

Energy Sec. James Watkins said, "The test sale should remove any doubts the SPR bidding and distribution system can function effectively and expeditiously. The system and the people who ran it performed virtually flawlessly and on schedule throughout every step of the sales process.

"Equally important, the private sector now has valuable experience in working with the SPR should we ever be forced to use it during an energy emergency."

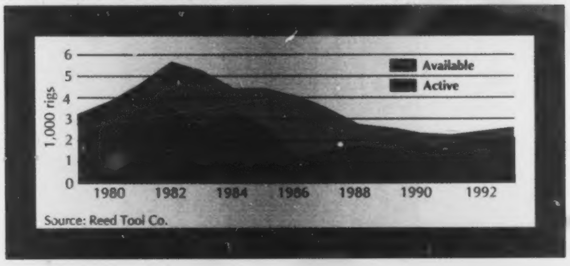
During the test, 26 shipments of crude were made from three of the reserve's six storage sites. The first shipment took place Oct. 19, 2 days after the first contracts were awarded, to meet an expedited request from one of the purchasers. Most deliveries were in November under normal scheduling practices.

About 3.7 million bbl of the 3.9 million bbl were shipped by pipeline and the remaining 255,000 bbl by barge.

Although all payments had not been computed by mid-December, DOE said the purchase price will average about

Fig. 3

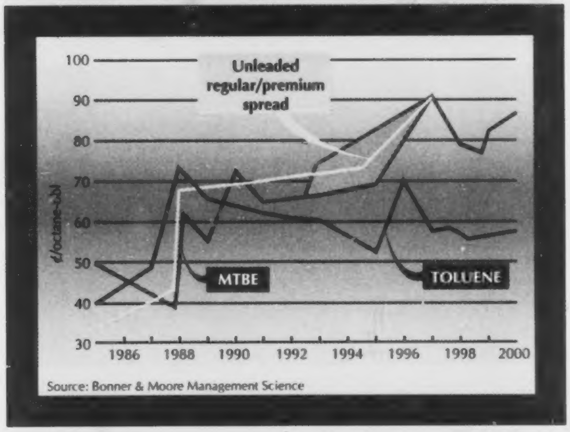
The rise and fall of U.S. drilling activity



Source: Reed Tool Co.

Fig. 4

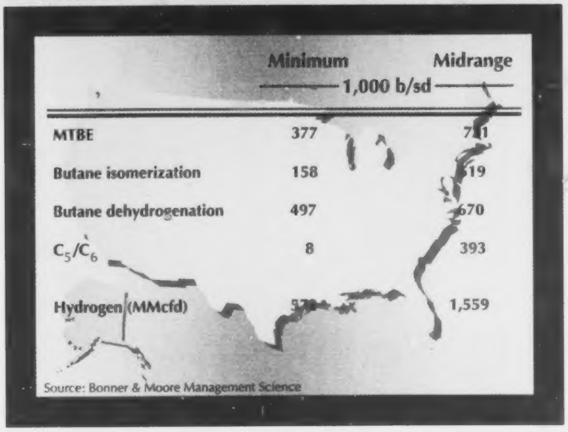
U.S. Gulf Coast octane costs, values



Source: Bonner & Moore Management Science

Fig. 5

Required U. S. capacity additions



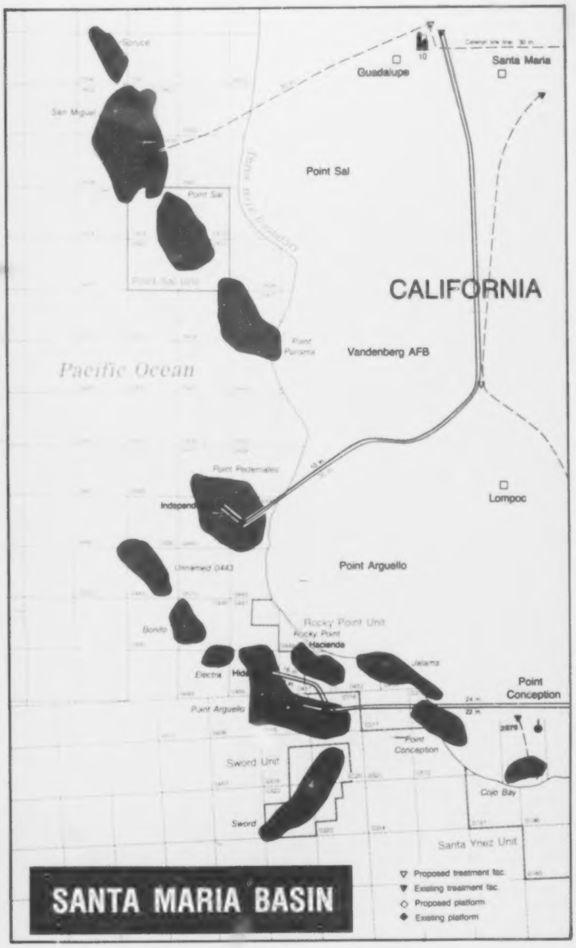
	Minimum	Midrange
	1,000 b/sd	
MTBE	377	7[illegible]1
Butane isomerization	158	[illegible]19
Butane dehydrogenation	497	670
C_5/C_6	8	393
Hydrogen (MMcfd)	57[illegible]	1,559

Source: Bonner & Moore Management Science

$30.10/bbl for sour crude to $33.30 for sweet. Those prices were about 13% below average winning bid prices because of adjustments under a price index system DOE used to track changes in the market price of various crudes.

The drawdown was the second for the SPR. In 1985 Congress ordered a 1 million bbl test sale. It went smoothly.

DOE has invested $3 billion in facilities and $16 billion in crude, paying an average $27.26 bbl.


Spruce
San Miguel
Point Sal
Point Sal Unit
Guadalupe
10
Santa Maria
Point Sal
CALIFORNIA
Point Purisima
Vandenberg AFB
Pacific Ocean
Point Pedernales
Independence
Lompoc
Unnamed 0443
Point Arguello
Bonito
Rocky Point Unit
Rocky Point
Hacienda
Electra
Hidalgo
Jalama
Point Arguello
Point Conception
24 in.
22 in.
Point Conception
Sword Unit
Sword
Cojo Bay
Santa Ynez Unit
▽ Proposed treatment fac.
▼ Existing treatment fac.
◇ Proposed platform
◆ Existing platform

SANTA MARIA BASIN

SPR sites are served by barges, tankers, and pipelines.

For example, the Bryan Mound site, 3 miles west of Freeport, Tex., is linked to Houston and Texas City refineries through a 42 in. DOE pipeline that connects to the area pipeline grid. It is in DOE's distribution system designated "Seaway" because it formerly was served by Seaway Pipeline, now converted to gas from crude oil service.

DOE's "Texoma" system once was served by a pipeline of that name, also now in gas service. Pipeline interconnections enable SPR crude from the Texoma system sites to move to Upper Midwest refineries.

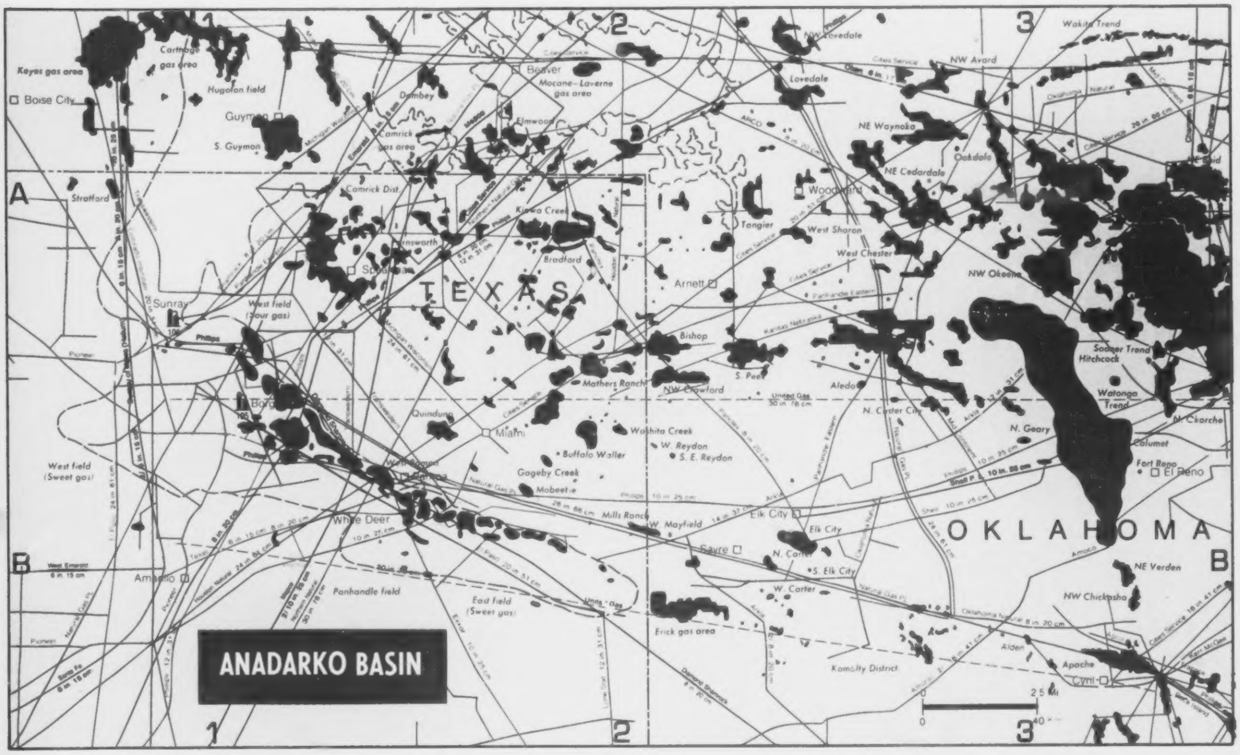
The third cluster of SPR sites is served by Capline Pipeline.

U.S. not likely to hike oil flow

The SPR is a valuable asset in U.S. energy supply because only Alaska and California can make a sizable near term contribution to boosting U.S. oil production, Oil & Gas Journal reported in October 1990.

In terms of current reserves, all other U.S. oil producing states combined could not ramp up production enough in 1 year to make much of a dent in the natural decline in U.S. oil fields, OGJ said.

Even with a strong effort from Alaska and California


ANADARKO BASIN
TEXAS
OKLAHOMA
A
B
1
2
3
Keyes gas area
Boise City
Carthage gas area
Hugoton field
Guymon
S. Guymon
Stratford
Sunray
West field (Sour gas)
West field (Sweet gas)
Borger
Amarillo
White Deer
Panhandle field
East field (Sweet gas)
Beaver
Mocane–Laverne gas area
Dombey
Camrick gas area
Camrick Dist.
Elmwood
Kiowa Creek
Ensworth
Spearman
Bradford
Arnett
Bishop
Mathers Ranch
NW Crawford
Quinduno
Miami
Washita Creek
W. Reydon
S. E. Reydon
Buffalo Waller
Gageby Creek
Mobeetie
Mills Ranch
W. Mayfield
Sayre
Elk City
N. Carter
S. Elk City
W. Carter
Erick gas area
Komalty District
NW Lovedale
Lovedale
NW Avard
Waketa Trend
NE Waynoka
NE Cedardale
Oakdale
Woodward
Tangier
West Sharon
West Chester
NW Okeene
S. Peek
Aledo
N. Custer City
N. Geary
Sooner Trend
Hitchcock
Watonga Trend
NE Okarche
Calumet
Fort Reno
El Reno
NE Verden
NW Chickasha
Alden
Apache
Cyril
25 Mi
0
40

production by 225,000 b/d by 1995. That assumes, however, that giant Point Arguello field off Santa Barbara is producing at peak by then.

Chevron Corp. and partners in November 1990 gave a green light to a midyear 1991 start-up of Point Arguello oil field despite their inability to win a tanker permit to move the oil to Los Angeles.

Instead, 20,000 b/d of Point Arguello crude will move via offshore and onshore pipelines to California refineries outside the Los Angeles area.

The project is permitted to produce as much as 100,000 b/d of crude, a volume Chevron pointed out is equal to about half the U.S. imports of Kuwaiti crude before Iraq invaded that country Aug. 2, 1990. A 1981 discovery with a likely minimum reserve of 300 million bbl, it is the biggest oil field found in U.S. federal waters.

Chevron hoped to accelerate its timetable to reactivate the three platforms, onshore and offshore pipelines, onshore oil and gas processing plants, storage tanks, and marine terminal built for the project. Chevron earlier said demothballing could take as much as 6 months, with another 6 months to build production to minimum expected peak of 75,000-80,000 b/d.

The $2.5 billion development project had been mothballed for 3 years because of environmental opposition.

Although California has a substantial amount of shutin productive capacity, the state's decimated service sector prevents it from stepping up production significantly in the near term.

Low oil prices left more than 14,000 wells idle in California for 5 years or more, said Marty Mefferd, the state's oil and gas supervisor.

"A lot of the wells are sitting there with production equipment intact," he said. "A number of those are still hooked to pumping units, and we're trying to get them started. For a lot of them, that just means pulling rods and

Table 2

U.S. energy consumption by source

	1986	1987	1988	1989	1990	1991	% change 1989-90	% change 1990-91
	Quadrillion BTU							
Petroleum*	32.20	32.87	34.23	34.21	33.83	33.46	−1.1	−1.1
Natural gas	16.71	17.75	18.55	19.33	18.80	19.26	−2.8	2.5
Coal	17.26	18.01	18.85	18.92	18.94	19.00	0.1	0.3
Hydro and geothermal	3.60	3.32	2.91	3.11	3.31	3.41	6.4	2.9
Nuclear	4.47	4.91	5.66	5.69	6.04	6.15	6.2	1.9
Total	**74.24**	**76.85**	**80.20**	**81.25**	**80.91**	**81.28**	**−0.4**	**0.5**

*Includes natural gas liquids, still gas, and liquefied refinery gas.

Source: Independent Petroleum Association of America supply/demand committee

Table 3

U.S. tubular goods supply, drilling activity, and footage drilled

Tubular goods	1980	1981	1982	1983	1984	1985	1986	1987	1988	1989	January 1989	June 1990	% change
	1,000 tons												1989-90
Mill shipments	3,612	4,241	1,759	677	1,406	1,299	483	919	1,130	909	392	583	48.7
Less exports	−133	−128	−67	−8	−12	−14	−36	−30	(74)	(320)	−176	−76	−56.8
Plus imports	1,036	2,389	2,180	565	2,214	1,506	617	570	988	429	176	174	−1.1
U.S. supply	**4,515**	**6,502**	**3,872**	**1,234**	**3,608**	**2,791**	**1,064**	**1,459**	**2,044**	**1,018**	**392**	**681**	**73.7**
Rotary rigs running*	2,912	3,970	3,106	2,232	2,428	1,980	964	936	936	869	841	953	13.3
Wells drilled†	69,486	89,234	84,054	76,280	84,983	70,806	39,015	36,253	34,015	30,401	13,689	14,973	9.4
	1,000 ft												
Footage drilled†	311,445	406,520	375,706	317,996	368,796	316,778	177,641	163,848	158,883	137,492	62,839	72,421	15.2
	Tons/1,000 ft												
Tubular goods used	14.5	16.0	10.3	3.9	9.8	8.8	6.0	8.9	13	13	6.2	9.4	50.7
	ft												
Average depth of wells	4,482	4,556	4,470	4,169	4,340	4,474	4,553	4,520	4,671	4,523	4,590	4,837	5.4
Rig census§	3,672	4,803	5,644	5,273	4,580	4,409	3,993	3,331	2,752	2,542	2,542	2,320	−8.7
Stacked	130	100	2,419	2,734	1,490	1,784	2,941	1,943	1,220	1,098	1,098	643	−41.4
Active	**3,542**	**4,703**	**3,225**	**2,539**	**3,090**	**2,625**	**1,052**	**1,388**	**1,532**	**1,444**	**1,444**	**1,677**	**16.1**

* Baker Hughes Inc. count of rigs drilling. † Excludes stratigraphic tests and service wells. § Reed Tool Co. count, excludes rigs not capable of drilling to more than 3,000 ft.

Source: Independent Petroleum Association of America cost study committee based on data from several sources

well producing oil by gravity drainage through three horizontal legs about 120° apart on the La Barge platform in Wyoming. Completion was in the low pressure Almy member of Eocene Wasatch with the laterals kicked from the same vertical well bore from the same kickoff depth.

Texaco's G634Y La Barge Unit, 34-27n-113w, Sublette County, was producing with a conventional vertical rod pump making about 30 b/d of oil and 3 b/d of water with no decline from a 24 in. underreamed, gravel packed, unstimulated zone in Almy at 415-520 ft. Most vertical Almy wells produced less than 10 b/d of oil.

The laterals with approximate direction and length were: north-northeast 133 ft, east-southeast 155 ft, and south-southwest 70 ft.

The 4 in. diameter laterals were jetted into Almy using a nonrotating nozzle through which water was pumped from surface through coiled tubing at 175 gal/min at about 10,000 psi.

Cretaceous Niobrara, a formation of interbedded chalks and calcareous shales, was the top horizontal target in Colorado and Wyoming. Niobrara horizontal drilling was planned or being attempted in the Denver, Sand Wash, and Hanna basins in the two states.

Rig utilization rate increases

The number of active rotary rigs in the U.S. continued a 4 year upward trend during 1990, while the number of available rigs continued to slide.

A midyear survey by Reed Tool Co., Houston, found 1,677 rigs working out of 2,320 available, a utilization rate 15 percentage points higher than at the same time in 1989 (Fig. 3).

In 1989, Reed counted 1,444 rigs working out of 2,542 available, a 57% utilization rate.

U.S. rig utilization increased for the fourth straight year since the rate plummeted to 26% with the crude oil price collapse of 1986, when only 1,052 of 3,993 rigs were active. The number of available rigs counted yearly by Reed has decreased since 1982, when the U.S. fleet climbed to a record 5,644.

Reed considered a rig available if it worked during the preceding 3 years and can be returned to service with an investment of $50,000 or less. It considered a rig active if it worked during Reed's 15 day census or during the 30 days preceding the summer survey period.

Reed Pres. Roy Caldwell said increasing drilling will trim attrition of the rig fleet during 1991 to half that of the past 2 years.

Reed's census found that the number of drilling contractors in the U.S. declined to 500 in 1990 from 558 in 1989. Of the 191 contractors who left the drilling business since 1987, 181 owned fewer than 10 rigs.

Of the 1990 count, 221 contractors owned two to five rigs and 170 owned only one. The average contractor owned a little less than five rigs.

Ninety percent of 273 companies surveyed by Reed cited low contract rates as a major impediment facing drilling contractors, 70% cited crew shortages, 55% drill pipe shortages, and 32% lack of financing.

Yet companies reported an average of 18,000 ft of drill pipe/rig, and 2.7 crews/rig, a 10% personnel shortfall. Thus, Reed concluded that low contract rates and cash flows were the greatest threats to maintaining an adequate U.S. drilling industry.

Reed found that 382 rigs had left the U.S. fleet since last year and 160 had been added for a net decline of 222 rigs.

Among the losses were 82 rigs that had been stacked for 3 years or longer, 105 rigs costing $50,000 or more to return to work, 166 cannibalized, 23 moved out of the U.S., and six destroyed or vandalized.

On the plus side, 116 rigs that had fallen from earlier Reed counts were put back in service, 40 rigs were built from available components, and four were moved into the U.S.

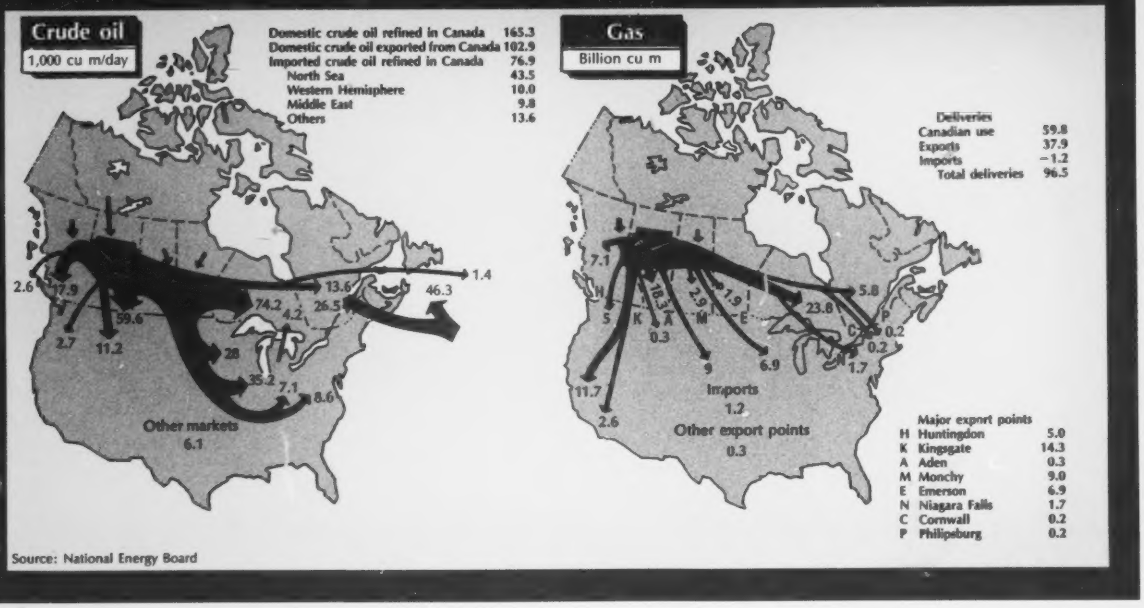
"There were no newly manufactured rigs reported in this year's fleet," Caldwell said. "Some contractors apparently found it cheaper to refurbish older rigs than pay transportation costs to move in newer rigs from other areas."

Availability of U.S. offshore rigs reached its lowest level since 1976, when 240 rigs were available.

Reed's 1990 census showed the U.S. offshore rig fleet decreased since 1989 by 34 to 259 rigs, while activity climbed by three rigs to 205. Rig use increased to 79%, a 10 percentage point rise since the 1989 census.

Fig. 1

Where Canada's oil and gas shipments go


Crude oil
1,000 cu m/day
Domestic crude oil refined in Canada 165.3
Domestic crude oil exported from Canada 102.9
Imported crude oil refined in Canada 76.9
North Sea 43.5
Western Hemisphere 10.0
Middle East 9.8
Others 13.6
2.6
17.9
59.6
2.7
11.2
74.2
4.2
13.6
26.5
1.4
46.3
28
35.2
7.1
8.6
Other markets
6.1
Gas
Billion cu m
Deliveries
Canadian use 59.8
Exports 37.9
Imports −1.2
Total deliveries 96.5
7.1
H
5
K
18.3
A
0.3
2.9
M
7.9
E
23.8
5.8
C
P
0.2
0.2
N
1.7
9
6.9
11.7
2.6
Imports
1.2
Other export points
0.3
Major export points
H Huntingdon 5.0
K Kingsgate 14.3
A Aden 0.3
M Monchy 9.0
E Emerson 6.9
N Niagara Falls 1.7
C Cornwall 0.2
P Philipsburg 0.2

Source: National Energy Board

U.S. DOE giving U.S. companies permission to import Canadian gas through the Niagara Import Point Projects (Nipps) to the U.S. Northeast.

Nipps involves construction of 545 miles of line by seven U.S. interstate pipeline companies, increasing the capacity of a pipeline system that begins at the Minnesota-Manitoba border, crosses Wisconsin and Michigan back into Canada, then returns to the U.S. at Niagara, N.Y.

About 545 miles of loops by seven U.S. interstate pipeline companies, along with 61,300 hp of added compression, will open the way for an additional 346.4 MMcfd of gas to be shipped to U.S. customers as far south as Virginia.

Canada's 1989 gas exports were up 4.5% from 1988's 5.9 billion cu m. California accounted for 37% of Canada's export sales, the central region of the U.S. 40%, Pacific Northwest 13%, Northeast 8%, and the mountain region 2%.

Export prices averaged $1.90 (U.S.)/MMBTU, flat with 1988's $1.88.

Access to U.S. pipeline systems continued to improve, and by yearend 1989 almost all major U.S. gas pipelines were open access carriers.

This aided rapid growth in Canadian short term sales, which grew to 13.8 billion c m in 1989 from 11.3 billion cu m in 1988. Short term sales accounted for about 37% of total gas exports in 1989, compared with 30% in 1988 and only 22% in 1987.

British Gas purchase of Consumers

Among other gas developments, British Gas plc, London, was closing in on its planned $1.1 billion (Canadian) takeover of Canada's largest gas utility.

The purchase of Consumers Gas Co. Ltd., Toronto, won approval in November 1990 from Investment Canada, a federal foreign investment screening agency. That action followed approval by the Ontario Energy Board, an agency of the province's New Democratic government.

Consumers serves more than 1 million natural gas customers in Ontario, Quebec, and New York state. The company was being sold by GW Utilities Ltd., controlled by the Reichmann family.

Among other things, British Gas agreed to make a public offering of 15% of Consumers shares by 1992, spend $30 million by Dec. 31, 2000, in Ontario for research and development focusing on efficient, "environmentally friendly" use of natural gas, make available at least $50 million (Canadian) for investment during the next 10 years in Ontario cogeneration projects to be chosen by British Gas, and create a $5 million venture capital fund to invest in Ontario energy and environmental technology during the next 5 years.

If the fund is fully spent at the end of that time, British Gas will invest another $5 million during the next 5 years.

The provincial approval was seen as a test of the New Democratic party government's relationship with the business community.

The party's previous policy called for Canadian ownership

Fig. 2

Hibernia production system

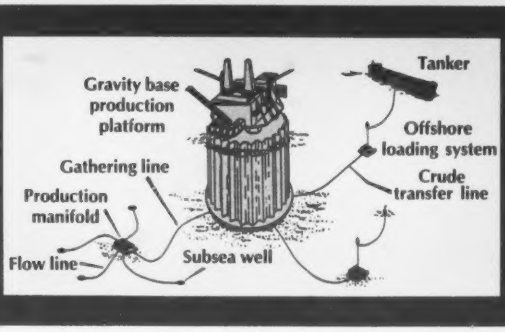

Gravity base production platform
Tanker
Offshore loading system
Gathering line
Crude transfer line
Production manifold
Flow line
Subsea well

Table 1

Breakout of the Canadian industry's financial performance

	1980	1981	1982	1983	1984	1985	1986	1987	1988	1989
	Billion current $ (Canadian)									
Revenues										
Total operations*	44.2	53.0	57.2	59.3	62.7	66.3	47.6	49.2	47.0	50.2
Upstream	16.1	17.3	21.0	24.0	26.7	28.0	17.0	17.9	15.8	17.2
Downstream	24.8	30.5	31.3	30.7	31.2	33.4	26.2	27.0	27.0	28.8
Internal cash flow										
Total operations*	9.6	8.4	7.4	8.7	10.8	11.6	8.0	9.4	9.0	8.9
Upstream	6.7	5.3	5.8	7.4	8.5	9.5	5.5	6.8	5.8	6.4
Downstream	2.2	2.1	1.3	0.8	1.1	1.1	1.7	1.7	2.3	1.9
Net income										
Total operations*	4.7	3.2	1.8	1.6	3.5	3.3	−2.8	3.2	2.2	1.3
Upstream	2.9	1.7	2.1	2.5	2.9	3.3	−1.9	2.0	0.8	0.6
Downstream	1.5	1.4	0.4	−0.1	0.4	0.2	0.8	0.9	1.5	0.9
Capital expenditures										
Upstream	6.9	6.9	6.5	6.8	8.0	9.3	6.3	5.5	6.8	5.4
Downstream	0.8	1.6	2.2	1.6	0.9	0.8	0.7	1.1	1.2	1.2
Other	0.6	1.7	1.9	1.2	0.9	0.9	0.4	0.4	0.6	0.6
Total in Canada	8.3	10.2	10.6	9.6	9.8	10.9	7.4	7.1	8.5	7.2
Expenditures abroad	1.1	1.8	1.2	0.8	0.7	1.2	0.6	0.5	0.6	0.5
Total capital outlays	**9.4**	**12.0**	**11.8**	**10.4**	**10.5**	**12.1**	**7.9**	**7.6**	**9.1**	**7.7**
Dividend payments	1.0	1.2	1.1	1.3	1.4	1.8	2.6	1.5	2.5	1.4
Total capital employed	**43.9**	**59.9**	**66.1**	**69.0**	**81.2**	**82.9**	**73.4**	**73.7**	**76.0**	**78.0**
	Percent									
Total reinvestment rate	100	136	138	101	81	87	88	75	96	85
Upstream reinvestment rate	103	114	86	70	72	77	98	74	110	82
GNP deflator	100.0	111.8	124.2	132.0	135.8	139.5	142.6	147.6	151.7	156.6

*Includes other Canadian and foreign operations.

Source: Petroleum Monitoring Agency

Accord between the two governments.

E&P efficiency slide continues

Canada's oil and gas industry's efficiency in terms of finding costs and production replacement continues to falter, said Canadian Oil Patch Analyst Inc. (COPA) in a late 1990 report.

A COPA study based on analysis of 46 companies, including most major Canadian producers, showed the 5 year rolling average finding and development cost for 1985-89 was more than $9/bbl of oil equivalent (BOE), 4% higher than the previous 5 year average (Fig. 3).

Further, the 1989 replacement cost of $8/BOE was higher than in the previous 2 years.

COPA found that highgrading of plays common after the 1986 oil price crash seems to have reached its limits, as seen in declining production replacement rates. For the first time in 5 years, revisions of reserves in 1989 exceeded discoveries and extensions.

The 46 companies added 1.755 billion bbl of liquids reserves during 1985-89, replacing 85% of production but just 46% through discoveries and extensions.

Companies are finding it more difficult to replace oil production with discoveries and extensions, COPA said, in part because of low prices, diversion of funds to debt payments or acquisitions, and lack of elephant scale discoveries.

"As a consequence, the industry—especially the senior sector—has begun to rely more on engineering generated revisions to replace production, similar to the U.S.," COPA said.

The companies' gas reserve additions during 1985-89 totaled 7.1 tcf, replacing 63% of production. The low gas replacement figure, however, is due to large reserve write-downs and has little effect on the deliverability surplus because of the relatively long reserve life of Canadian natural gas, COPA said.

Table 2

Key dates in Hibernia schedule

1990
October—Work begins at Bull Arm, Newf., construction site

1991
August—Bull Arm site completed

1992
April—Gravity base structure drydock completed
June—Module fabrication begins

1993
April—Engineering and construction of offshore loading system begins
April—Order shuttle tankers

1994
April—Module assembly and hookup begins

1995
March—Mating of base structure and topside begins
May—Inshore hookup begins
August—Tow-out to production site
September—Installation of offshore loading system begins

1996
April—Development drilling begins
July—Delivery of first two shuttle tankers
October—Production begins

1997
September—Delivery of third shuttle tanker

China's oil production, exports

	Crude production	Exports	
		Crude	Products
	Million b/d	1,000 b/d	
1975	1.541	198	44
1976	1.743	170	39
1977	1.873	182	39
1978	2.081	226	43
1979	2.123	269	61
1980	2.119	266	84
1981	2.024	277	92
1982	2.042	304	105
1983	2.121	298	108
1984	2.296	446	120
1985	2.498	601	124
1986	2.622	570	109
1987	2.683	545	99
1988	2.740	550	94
1989	2.750	490	90
1990	*2.756	391	—

*From Central Intelligence Agency, International Energy Statistical Review.
Source: Geopolitics of Energy, after other sources

China's 1990 oil and gas production*

Producing area	Oil 1,000 b/d	% of annual plan	Gas MMcfd	% of annual plan
Daqing	1,124	58.4	218	58.9
Shengli	672	57.8	138	56.4
Huabei	109	59.3	24	68.5
Liaohe	273	58.1	171	59.8
Xinjiang	134	56.7	48	—
Dagang	77	54.8	34	56.2
Henan	50	56.7	4	—
Zhongyuan	127	53.0	136	59.7
Jilin	72	62.3	10	—
Changqing	30	61.0	3	—
Jianghan	17	57.7	7	—
Yumen	11	68.2	1	—
Jiangsu	17	64.5	4	—
Qinghai	15	41.8	4	—
Sichuan	—	75.8	636	61.0
Jidong	7	41.6	3	—
Offshore	20	56.7	—	—
Total	**2,755**		**1,441**	

*First 7 months.
Source: China National Petroleum Corp.

Low risk venture

Myung is intent on keeping the Hainan venture as low risk as possible.

China declared Hainan Island, formerly part of mainland Guangdong Province, a special economic zone and granted it provincial status in 1988.

For the commitment wells, Myung can reduce drilling day rates to $6,000-7,000/day with an Oklahoma rig vs. a typical international rate of $10,000-12,000/day. The toolpusher, geologist, and engineer on the job will be Myung staff, the drilling crew Chinese.

Myung planned to ship a truck mounted rig and logging truck from Oklahoma for the two wells and possible future drilling.

Natural gas activity

China is stepping up its efforts to find and utilize more natural gas.

Xinhua reported the Ministry of Geology and Mineral Resources' Institute of Petrogeology increased the estimate of China's potential gas resource to 1.4 quadrillion cu ft.

Previous estimates ranged from 918 tcf to 1.16 quadrillion cu ft.

Those estimates exclude a coalbed methane potential resource of 582 tcf, Xinhua reported.

China produced 1.4 bcfd of gas in 1989.

New potential

Although most Chinese gas production comes from Sichuan province, explorationists are stepping up efforts to find more gas in China's frontier areas.

Garnering increased interest for gas potential is Northwest China's Shaanxi-Ninqxia-Inner Mongolia basin, reported Xinhua.

Gas was first discovered there in 1986, and 43 wells have been drilled in the eastern and central parts of the basin, which covers parts of Inner Mongolia autonomous region and Shaanxi province. Of 24 discovery and extension wells drilled there, half yielded at least 7 MMcfd. The biggest flowed 10.6 MMcfd.

Pay is relatively shallow at 10,500 ft, with the gas of good quality and production relatively uncomplicated, Xinhua reported.

The regional Changqing petroleum administration has formed 10 exploration teams to further delineate the extent of pay there to pave the way for Congedc development.

Sichuan potential

Sichuan province accounts for 43% of China's gas output, producing about 606 MMcfd in 1989, Chen Gengtao reported for China Features.

Runnerup Daqing complex produced about 218 MMcfd that year.

With oil production in China concentrated in the Northeast and North coastal areas, gas provides fuel or feedstock to one third of industrial operations and many residential customers in Sichuan, according to Fan Youzhen, deputy director of Sichuan Oil Administrative Bureau (SOAB). Sichuan is China's most populous province.

SOAB faces the task of ramping up production to meet projected demand in the province during 1991-95, Chen wrote. Early estimates put Sichuan gas demand at 822 MMcfd and provincial production at only 726 MMcfd by 1995.

Sichuan's natural gas resource base is estimated at 282 tcf. However, proven reserves total only 9.9 tcf, reflecting a low level of exploration, Chen wrote.

Modern exploration for gas in Sichuan did not begin until 1949. Since then, SOAB has identified 240 structures, discovered 73 fields, and by yearend 1989 had produced 4.2 tcf of gas.

Sichuan production

SOAB has five production areas that yield a combined 530-600 MMcfd of gas, Chen wrote.

The southern area, centering on Luzhou, was first to go on stream, and is declining at a rate of 7%/year. Current production is 117 MMcfd.

The southwestern area around Zigong also is in decline, producing about 102 MMcfd.

Efforts are under way to boost production in the northwestern area, around Jiangyou. Production there is about 69 MMcfd. SOAB discovered a large gas field in Qionglai county west of provincial capital Chengdu.

The central area, around Nanchong, produces mainly

Recent activity

During late 1989 and early 1990, the Mongolian Geophysical Expedition acquired about 150 line miles of 1,200% digital common depth point reflection seismic data in the Nyalga basin.

In early 1990, the new Ministry of Heavy Industry, formerly the Ministry of Energy, Mining, and Geology, formed Mongolian Petroleum Co. (Mongol Gazryn Tos or MGT).

The company was formed to administer all petroleum related matters for the ministry and the government.

Subsequently, MGT staff members have been conducting geological exploration surveys in the field.

The geophysical expedition staff also has been conducting field exploration.

MGT is continuing a major effort to formulate a petroleum law with supplemental regulations.

It was the intent of the government to have the petroleum law and regulations submitted for debate and adoption by the Great People's Khural (congress) before yearend 1990.

In September 1990, during the reorganization of the government, the Ministry of Heavy Industry was dissolved. MGT, which was responsible to that ministry, now is an independent organization responsible to the government.

MYANMAR

CAPITAL: Rangoon
MONETARY UNIT: Kyats
REFINING CAPACITY: 32,000 b/cd
PRODUCTION: 13 Mb/d
RESERVES: 51,000 Mbbl

Myanmar issued licenses for all tracts in its first onshore licensing round, received bids for second round tracts, and was expected to invite bids for improved production in existing fields.

Foreign oil companies last operated onshore in Myanmar, formerly Burma, in 1962.

The licenses are expected to result in a combined $363 million work commitment during the first 3 years. Work commitments are $12-70 million/block for the 3 year exploration period.

A unit of Idemitsu of Japan signed a contract to study the feasibility of developing Martaban gas fields, with reserves of 4.1 tcf.

Prospects fertile

Myanmar's production has dropped to less than 15,000 b/d of oil from twice that volume in 1982.

The state oil company's production averaged 14,713 b/d of oil and 103.5 MMcfd of gas in 1989.

The industry response to the licensing offers results from good geological potential, relatively favorable fiscal terms, and encouragement toward industry from the Ministry of Energy, energy planning department, and the state company.

The Myanmar tertiary geosyncline covers about 140,000 sq miles, of which 111,000 sq miles could be considered to have hydrocarbon potential.

Many fields were discovered based on surface features, several contain five to 40 pay sands, and average producing depth is about 4,000 ft.

The potential for large discoveries is probably greatest in the Central basin (Salin basin) and southern Chindwin basin, Johnston said.

Almost all production in Myanmar is from Oligocene and lower Miocene sandstones.

Crudes are often high in paraffin content with pour points of 80-100° F.

Myanmar's main fields, production

		Production			
		Cumulative		Present	
Field	Year discovered	Oil Million bbl	Gas bcf	Oil b/d	Gas MMcfd
Mann	1960	19	—	6,800	6
Htaukshabin	1960	88	—	4,900	7
Chauk/Lanywa	1902	128	10	700	12
Yenangyaung	1800	192	—	2,500	2
Ayadaw	1910	1	10	—	10
Pyalo	1972	—	—	—	2
Prome	1965	7	—	300	5
Shwepyitha	1967	—	—	—	10
Myanaung	1964	21	—	—	—
Total				**15,200**	**54**

Source: Daniel Johnston & Co.

NEW ZEALAND

CAPITAL: Wellington
MONETARY UNIT: Dollars
REFINING CAPACITY: 95,100 b/cd
PRODUCTION: 39 Mb/d
RESERVES: 209,000 Mbbl

PETROCORP EXPLORATION (WAIHAPA) LTD. AND partners at yearend 1990 were proceeding with second stage development of Waihapa gas/condensate field in New Zealand despite continuing legal and political problems over oil and gas issues in that country. Delivery of first gas from Waihapa, in the onshore Taranaki basin, to a power plant at Stratford, N.Z., in late September 1990 marked the end of 2½ years of flaring during long term production tests.

First stage development, costing $8.4 million, entailed laying 4 mile, 7⅘ mile parallel oil and gas pipelines to Stratford, installing permanent wellhead facilities and flow lines for five producing wells, and linking the wells to a manifold at the Waihapa B site where the gas is collected for market. Waihapa joint venture partners, led by Petrocorp, are selling Waihapa gas to Electricorp for the Stratford power plant under a short term contract of 10.4 MMcfd.

Second stage development plans, costing $30 million, call for constructing permanent production facilities and extending the oil pipeline to the Omata tank farm at New Plymouth, N.Z. Condensate from long term production testing has been trucked to the tank farm. The new production center is to go on stream late in 1991 with initial capacity of 7,500 b/d, expandable to 15,000 b/d if needed for production from other fields in the Ngaere license contiguous to Waihapa or adjoining petroleum licenses such as Tariki and Ahuroa.

The Waihapa project has been stymied by lengthy licensing procedures as well as a legal dispute over ownership of the contiguous Ngaere license. Gas flaring, which began in February 1988 under an initial term petroleum mining license (PML), persisted while Petrocorp sought a market amid uncertainties over gas deregulation.

Flaring was reduced to minimal levels after the Waihapa joint venture received a specified term PML in July 1990. The joint venture had negotiated the gas sales contract with Electricorp in 1989 but was forced to await the permit before sales could begin. Production testing during the year ended June 30, 1990, averaged 5,871 b/d of liquids with a gas:oil ratio of 1,000:1. Waihapa reserves are estimated at 19 bcf of gas and 12.5 million bbl of liquids.

Saudi Aramco's capital and operating budget

	1990	1991	1992	1993	1994	1995	1996	1997	1998	1999	2000	Total
	Million current U.S. $											
Capital costs												
E&P	545	1,069	1,901	2,793	2,920	3,478	4,045	4,331	4,816	4,851	5,379	36,128
MS&T*	332	466	430	337	275	301	365	373	282	142	102	3,405
Support	112	196	298	401	409	484	564	602	653	639	701	5,059
Total capital	**989**	**1,731**	**2,629**	**3,531**	**3,604**	**4,263**	**4,974**	**5,306**	**5,751**	**5,632**	**6,182**	**44,592**
Operating costs												
E&P	499	526	556	620	734	828	897	990	1,121	1,258	1,347	9,376
MS&T*	818	887	969	1,052	1,131	1,208	1,291	1,383	1,479	1,573	1,661	13,452
Support	2,372	2,474	2,593	2,759	2,984	3,257	3,501	3,796	4,160	4,530	4,813	37,239
Total operating	**3,689**	**3,887**	**4,118**	**4,431**	**4,849**	**5,293**	**5,689**	**6,169**	**6,760**	**7,361**	**7,821**	**60,067**
Total	**4,678**	**5,618**	**6,747**	**7,962**	**8,453**	**9,556**	**10,663**	**11,475**	**12,511**	**12,993**	**14,003**	**104,659**

*Manufacturing, supply, and transportation.

was to have been an integral part of an earlier proposed delivery system, but work was suspended during the revolution. Completion of the line would be required for a new proposal, along with a substantial increase in capacity of the Kangan gas processing plant.

Meanwhile, Iran also is exploring the concept of bringing in international companies to assist in development of its oil and gas fields during the 1990s. Iran's oil minister said his country is talking to international companies about developnent of oil and gas reserves on a contract basis. The minister said the companies will not be offered equity or production sharing agreements. Companies will be paid from production of fields they develop or from other reservoirs.

Iran's main effort will be concentrated on developing new oil and gas reservoirs, although there are negotiations for help with secondary recovery projects. Pars gas field and the Mond very heavy oil reservoir might be developed with international help. The minister didn't rule out the possibility of foreign companies becoming involved in exploration, although he said, "Up to now we have not gone into this matter very seriously."

Oil production capacity is to be raised to 4 million b/d during 1991. And the minister said he expects Iran within 5 years to have ability to sustain production of 5 million b/d.

One of the key elements in Iran's reconstruction program is rebuilding Kharg Island terminal in the Persian Gulf, which was seriously damaged during Iran's 8 year war with Iraq in the 1980s. As 1991 neared, ETPM of France was awarded a $225 million contract to rebuild the terminal. Work is expected to take 2 years.

First contracts also have been placed for replacing storage capacity at the terminal. Sangyong Construction will build five 1 million bbl tanks and one 500,000 bbl tank. Throughout the war, Kharg Island remained Iran's major oil export terminal.

The project to link Iran with the Mediterranean through a 1,150 mile, 1 million b/d pipeline through Turkey has been dropped and there has been little activity on plans for a pipeline to a new terminal on Iran's Indian Ocean coast. ETPM also was awarded a $45 million contract to repair and expand Nasr platform in Sirri field. Prewar output of 50,000 b/d will be increased to 80,000 b/d.

Other fields were also badly damaged in the fighting. Salman field, on the border with Abu Dhabi, was hit by Iraqi air attacks and U.S. naval action. Before the war it was producing about 150,000 b/d.

Under a $300 million contract, two Japanese companies will restart production at 50,000 b/d and then install facilities to boost production to 220,000 b/d. South Korean companies are expected to participate in the offshore reconstruction program as a result of closer ties between Seoul and the Iranian government.

Korean companies also will participate in the second stage of the Vali Asr gas processing plant, where capacity is being raised to 2.8 bcfd from 1.2 bcfd to handle production from Nar and Kangan gas fields and boost gas export capacity.

Iran to build new refinery at Arak

NIOC has anounced that it let a contract in April 1989 for the construction of a grassroots, 150,000 b/d refinery to be sited some 200 miles southwest of Tehran near a pipeline at Arak, according to the Iranian Ministry of Petroleum. Startup of the refinery is scheduled for early 1993.

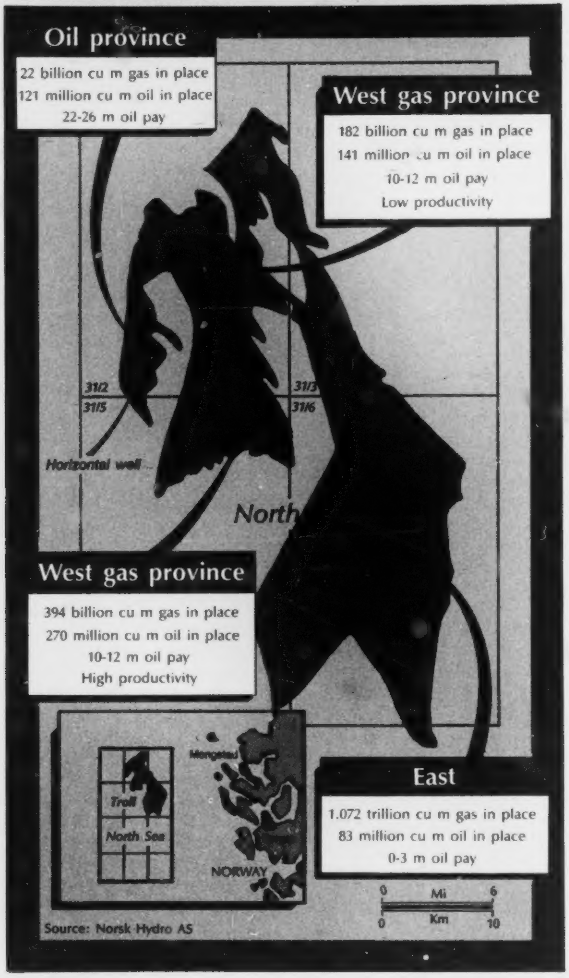
The contract for the refinery was awarded to a joint venture comprising JGC Corp., Tokyo, and Tecnologie Progetti Lavori SpA (formerly Technipetrol SpA), Rome. The contract price is $1.3 billion.

The refinery will include distillation and downstream processes, making it suitable to produce a full complement of light products and asphalt. The refinery will be designed to charge Ahwaz Asmari crude oil of 31.7° gravity and 1.66 wt % sulfur. The refinery will include steam and power generation facilities.

In other processing action:

- Iran let a $150 million contract to South Korea's Daelim Industrial Co. for a 300,000 metric ton/year ethylene plant at Bandar Khomeini in southern Iran. Construction is to begin this year. The project was begun in 1976 by a joint venture between an Iranian state company and a Japanese group led by Mitsui. It was interrupted by the Iran-Iraq war, then hobbled by a dispute between Iran and the Mitsui group, with the latter pulling out.
- Iran started up an 84,000 metric ton/year methanol plant at Shiraz petrochemical complex. Methanol will feed a planned $70.6 million, 16,000 metric ton/year melamine plant and possibly later a methyl tertiary butyl ether plant under study.
- Iran let a $28.9 million contract to Air Liquide, Paris, for design and construction of three industrial gas units at two petrochemical complexes, all due on stream by yearend 1991. Shiraz will get a 5,000 ton/year argon unit. Arak's ethylene oxide plant will get 450 ton/day oxygen and nitrate units.
- NIOC let a contract to Chiyoda Corp. of Japan and Snamprogetti SpA of Italy to build a 240,000 b/d refinery at Bandar Abbas on the approaches to the Strait of Hormuz. The $1.2 billion plant is to be on stream in 1993.

Troll field reservoirs


Oil province
22 billion cu m gas in place
121 million cu m oil in place
22-26 m oil pay
West gas province
182 billion cu m gas in place
141 million cu m oil in place
10-12 m oil pay
Low productivity
31/2
31/3
31/5
31/6
Horizontal well
North
West gas province
394 billion cu m gas in place
270 million cu m oil in place
10-12 m oil pay
High productivity
Mongstad
Troll
North Sea
NORWAY
East
1.072 trillion cu m gas in place
83 million cu m oil in place
0-3 m oil pay
0 Mi 6
0 Km 10

Source: Norsk Hydro AS

The gas originally was sold for power generation, but the power station project was canceled, leaving as much as 25 MMcfd gas without a buyer when Veselfrikk reaches plateau production.

Veslefrikk gas will be stored in Statfjord or Heimdal field until a sales contract is arranged. Statoil's action could set a trend for other small parcels of gas that may become available.

Danish, Dutch gas

Danish offshore gas production, currently controlled exclusively by Dansk Undergrunds Consortium (DUC), could benefit from plans by the administration in Copenhagen to promote gas use in an effort to reduce pollution.

Unlike its neighbors in Netherlands and Norway, Denmark does not have access to massive untapped gas reserves. Remaining reserves at the beginning of 1990 were 4.45 tcf, all under the control of DUC.

Production from Tyra gas field and of associated gas from DUC's offshore oil fields has averaged about 265 MMcfd. All is sold to the state monopoly Dangas.

DUC has medium term plans to develop Harald and Roar fields under a new flexible gas contract that could help meet future requirements of a more environmentally oriented Danish energy policy.

Denmark is a relative newcomer to the use of gas. Outlets have been established in the industrial and domestic markets and for district heating projects. Only about 7.5% of total supply goes into power generation. Demand in 1990 was expected to be about 215 MMcfd.

To absorb its contract volumes from DUC, Dangas signed four export contracts with Swedegas and Ruhrgas.

The contracts expire in 2003-06. Dangas is exporting a little less than 100 MMcfd, but the contracts have a plateau level of 145 MMcfd. With sustained domestic growth and the export contracts, Dangas's requirements might rise to 375 MMcfd in 1995 from 310-315 MMcfd in 1990.

Dutch North Sea gas production averages about 1.7 bcfd. All gas is sold to Gasunie, which uses a price formula that allows very small discoveries to be linked into the extensive gas transportation system.

The Dutch government's policy is to maintain those favorable terms and keep a steady stream of new development proposals coming forward so reserves from giant onshore Groningen gas field can be conserved.

Other U.K. sector activity

BP Exploration's program of high angle wells on the periphery of Miller field in the U.K. North Sea resulted in the most demanding well undertaken by the company's drilling department.

The seven wells were being drilled from a template with the Santa Fe 135 semisubmersible prior to installation of the platform in 1991. Miller is to start up in early 1992 and produce about 113,000 b/d.

The fifth well in the program, 16/8b-AO5(37), a water injector, generated torque that stretched the rig's 38,000 ft/lb capacity top drive to its limit.

As a contingency, BP considered subsea completions for water injection, but they were not required because well AO5 demonstrated that the high angle wells were achieveable from the template.

In addition to operating at unprecedented torque levels, the drilling department had to deal with a number of unscheduled problems. A differentially stuck pipe forced a time consuming plugback and sidetrack, followed by a broken logging cable and a small well kick.

Field developments

Scott, with 450 million bbl of oil reserves, was at yearend 1990 the biggest oil field under development in the U.K. North Sea.

Associated gas production will start in early 1994 and peak at 90 MMcfd.

It will be transported through the Mobil-operated SAGE gas line to St. Fergus, Scotland. From St. Fergus, Mobil plans to distribute the gas using the BG distribution network.

The U.K. Department of Energy approved two new development projects in the central U.K. North Sea.

Marathon Oil U.K. Ltd. received the go-ahead for 1.5 tcf/300 million bbl East Brae gas/condensate field in Blocks 16/3a and 16/3b. Agip U.K. won the nod to develop 40 million bbl Toni oil field in Block 16/17 as a satellite to its Tiffany development.

Amoco (U.K.) Exploration Co. will use an innovative X-braced tower design for three platforms in its Everest, North Everest, and Lomond gas development projects.

The design concept, developed in house by Amoco, allows each of the three jackets to be installed in a single crane lift and provides a greater topsides area on which

Fig. 1

Indonesia's oil, gas balance of payments*

	Fiscal 1987-88 at $17.50/bbl	Fiscal 1988-89 at 16/bbl§	Fiscal 1988-89 at 15/bbl	Fiscal 1988-89 at $14/bbl§
	Billion U. S. $			
Net oil	2.334	2.229	1.532	1.431
Net LNG	1.426	1.345	1.483	1.298
TOTAL	3.760	3.574	3.015	2.729

*Exports less imports and srevice payments for oil, srevice for gas. †Actual oil price. §Budgeted oil price. Source: Bank Indonesia

run newbuildings will be required if trade is to expand at the forecast rates.

Drewry cited 1989 as a golden year for LPG shipping companies with freight rates at record highs, reflecting, in part, continued growth in seaborne trade.

Other positive factors for carriers were a static fleet at 7.8 million cu m capacity and the increasing concentration of vessel ownership in the hands of a small number of companies.

The report said if the volume of tanker orders in 1989 is not repeated in 1990, projected increases in LPG trade will absorb capacity on order.

As a result, freight rates for most sizes of LPG tankers appeared set to remain comparatively buoyant for the next 1-2 years.

Indonesia drives to hike shipments

Faisal Abdaoe, president of state owned Pertamina, late in 1990 told newsmen in Jakarta Indonesia's LNG exports will total 20.7 million tons for the year, then rise to 21.7 million tons in 1991 and 24 million tons/year by 1994.

The occasion was a signing ceremony for a contract in which Pertamina agreed starting in 1994 to ship another 2 million tons/year of LNG for 20 years to Osaka Gas, Tokyo Gas, and Toho Gas, three of Japan's major LNG importers.

Under earlier contracts, Indonesia shipped 16.5 million tons of LNG to Japan, 2 million tons to South Korea, and 1.5 million tons to Taiwan in 1998.

The additional LNG to be supplied to Japan will come from Bontang, East Kalimantan, where Pertamina will add a production train with design capacity of 2.3 million tons/year. In cooperation with foreign oil and gas companies, Pertamina operated five LNG trains in Bontang and six in Arun, Aceh.

The new train at Bontang will cost $637 million, to be obtained in the form of loans. Eight companies from Japan, the U.S., and France have shown interest in providing required credits, Abdaoe said.

Pertamina also was negotiating a short term and a long term contract to sell Korea Gas Co. 44 million tons of LNG during 21 years.

Talks also were under way on an agreement to ship Singapore 140 MMcfd of LNG for 15-20 years from Block D in Natuna field.

There also were plans to increase Indonesia's LNG shipments to Taiwan by at least 700,000 tons/year, Abdaoe said.

Among Indonesia's newest projects, PT Badak NGL Co. in summer 1990 started up the fifth 2.3 million ton/year gas liquefaction train at the Badak LNG plant on the east coast of East Kalimantan at a cost of about $294 million. PT Badak capacity is 11.5 million tons/year of LNG and 400,000 tons/year of LPG.

Chiyoda Corp. handled engineering design and construction, and Union Carbide Co. provided its solvent gas treating technology for the plant.

Prior to the gyrations in oil prices set off by the Aug. 2, 1990, seizure of Kuwait by Iraq, Indonesia expected LNG and LPG exports to surpass oil exports as the biggest source of its foreign exchange in the 1990s.

As Indonesia's crude oil reserves dwindle, foreign demand for its LNG is expected to accelerate. The nation was stepping up the search for gas to expand its share of world LNG exports.

Indonesia accounted for a little more than 40% of world LNG exports in 1988. That's the last full year for which data were available when the American Gas Association published its November 1990 Gas Energy Review (Table 2).

In an April 1990 report, Bank Indonesia said although LNG accounted for less than one third of petroleum export revenues in fiscal 1988-89, almost half the petroleum sector's total contribution to net foreign exchange earnings came from LNG. The government forecast that relationship would stay the same in fiscal 1989-90, based on a very conservative budgeted oil price of $14/bbl (Fig. 1).

"However, with additional LNG sales being negotiated and facilities being expanded, LNG export earnings may surpass those of oil on a net basis next fiscal year and in gross export revenues within 5 years," the bank said.

Indonesia also will continue to increase its use of indigenous gas.

Total domestic use of Indonesian gas is expected to jump to 1.7 bcfd by 2000 from 1990's 850 MMcfd.

Notable in that scenario are the country's efforts to develop a domestic petrochemical industry to trim surging imports. A group of Indonesian banks, along with the Bank of Japan, agreed to fund construction of a $200 million plant at Cilegon, West Java, to produce 200,000 metric tons/year of polypropylene. That will help back out imports costing about $800 million/year.

More Indonesian exploration is targeted toward gas, notably near Natuna Island in the South China Sea, where about half of Indonesia's 90 tcf of gas reserves lies.

During 1982-88, Indonesian gas production climbed to almost 5 bcfd from about 3 bcfd.

Indonesia's LPG exports to grow

In 1988, Indonesia positioned itself to become a major exporter of LPG with start-up of new Arun and Bontang fractionators at a cost of more than $800 million.

The two plants, with a combined capacity of 2.25 million metric tons/year, will provide 1.95 million tons/year to Japan under a 10 year contract.

Indonesian LPG production jumped by 61% to 1.25 million tons in 1988. During first half 1989, Indonesian LPG exports totaled 1.24 million tons. With the first full year of expanded production, LPG exports could reach 2.7 million tons.

Before the Arun and Bontang LPG plants were completed, Indonesian LPG production was limited to four LPG recovery units in oil fields with associated gas and four LPG recovery units at refineries operated by Pertamina.

To upgrade the refinery LPG for export, Pertamina and a group of Japanese companies installed a $68 million, 450,000 ton/year fractionator in 1986 at Tanjung Uban, Bintan Island. The Tanjung Uban unit was last reported operating below capacity because of limited refinery LPG feedstock.

Indonesia had more LPG capacity under construction and planned further capacity additions. Its LPG production capacity was expected to increase to 3 million tons/year in the early 1990s, according to government forecasts.

Indonesia's government also was pressing a campaign for increased domestic consumption of LPG to back out kerosine use. Domestic consumption of LPG had increased fivefold in the preceding 10 years.

A World Bank study estimated that by 2000 LPG will replace 20% of Indonesia's kerosine demand, currently about 123,000 b/d. Government estimates peg domestic LPG demand at 350,000 tons in fiscal 1990 and 464,00 tons in fiscal 1993.

Japan to keep role as No. 1 LNG importer

Japan will retain its title as the world's top consumer of LNG for the next 20 years, the July 1990 issue of Geopolitics of Energy predicted.

Meanwhile, said the monthly publication of Conant & Associates Ltd., Washington, D.C., the U.S. LNG market will remain stagnant through 2010, and Europe's may even decline.

Both of those regions will depend more on domestic gas resources and on pipelines.

Overall, the volumes of internationally traded gas moved through pipelines will far exceed those shipped as LNG by tanker because the U.S. and Europe hold reserves of their own or have access to transborder gas pipelines.

Japan, however, receives about 70% of the world's LNG exports and uses half of the world's LNG tankers. Geopolitics of Energy said it is unlikely Japan will greatly reduce its share because there are no major gas reserves in East Asia.

In fact, Korea, Taiwan, and China also are likely to increase their shares of global LNG consumption, although to a lesser extent. By 2000, Asian demand is expected to total 56.2 million tons/year, World Gas Intelligence reported, but only 38.2 million tons/year of production capacity were on order or planned.

Japan is forecast to require 57 million tons/year of LNG by 2010 (Table 3).

Korea, Taiwan, and China could require a total 75 million tons/year by then.

Although Indonesia, Malaysia, and Brunei are likely to remain Japan's largest sources for LNG, Australia is making a big push to step up its exports.

Australia has spent $14 billion (Australian) on a project to make gas exports the country's major hard currency source in the 1990s.

It will have seven LNG carriers shipping to eight Japanese utilities, with intent to meet 15% of those companies' requirements by the mid-1990s.

LNG from the Yukon Pacific project proposed to tap Alaska's North Slope gas is deemed a comparatively expensive source, and supply was still uncertain, Geopolitics of Energy said. Japan may "reluctantly" agree, however, to accept deliveries of North Slope LNG out of deference to U.S. concerns about its trade deficit.

Other Japanese supplies will come from more distant sources such as Abu Dhabi and Qatar.

Tokyo's persistent, wide ranging search for gas sources stems from the costliness of the LNG industry.

It is a risky business, Geopolitics of Energy pointed out, and could become much riskier if LNG evolves into another spot trade.

"But the risks are less with Japan, which is likely to calculate its needs carefully and maintain competition between sources."

It is doubtful that LNG imports by the U.S. will play a much more important role in the next 2 decades, Geopolitics of Energy said. If supply and demand forecasts are not off by more than 1-2 tcf, the U.S. will need no more LNG than its present terminal capacity of 800 MMcfd, or about 3-4% of total gas demand. The reason, Geopolitics of Energy said, is that the U.S. gets at least 80% of its gas supplies from domestic sources and almost all of the rest from Canada via transborder pipelines.

Europe, with large gas reserves of its own, is close to huge Soviet reserves and to potential supplies in the Middle East, also deliverable by pipeline.

In addition, seabed pipelines developed by Algeria, Italy, and France will increase the efficiency of gas supplies from North Africa and eventually the Middle East. Seabed pipelines, said Geopolitics of Energy, may have permanently changed the logistics of gas trade in Europe.

"It is conceivable that after the next several decades, LNG to Europe may be only a memory, as pipelines connect the continent to oil suppliers, especially to those in the Persian Gulf."

Table 1

What's ahead for seaborne trade in...

	1987	1988	1989	1990	1995
...LNG...					
	Million metric tons				
Total tanker shipments	40.9	44.2	45.0	52.0	62.5-73.5
Imports					
Japan	29.1	31.0	32.4	34.5	37.5-42.5
U.S.	0.1	0.4	0.9	2.4	5.0-7.0
Europe	10.2	10.9	9.8	12.0	15.0-18.0
Average number of idle tankers	16	14	9	7	—
	Million U.S. $				
Newbuilding price*	120.0	145.0	175.0	220.0	NA
...and LPG					
	Million metric tons				
Total tanker shipments	26.2	26.9	28.1	31.1	35.0
Imports:					
Japan	12.7	12.7	14.0	15.2	16.4
Western Europe	7.5	7.0	7.1	7.3	7.9
U.S.	2.8	3.0	2.5	3.2	4.8
	Million cu m				
Tanker supply†	7.6	7.7	7.8	9.2	9.6
Tanker demand†	6.6	6.9	7.4	8.0	8.9
Average time-charter rate					
	$1,000 (U.S.)/month				
75,000 cu m	580.0	695.0	1,130.0	1,800.0	NA
12,000 cu m	330.0	450.0	550.0	530.0	NA
Average new building price					
	Million U.S. $				
75,000 cu m	51.0	58.0	66.0	71.0	NA
12,000 cu m	23.0	27.0	34.0	37.0	NA

*125,000 cu m capacity tanker. †Ships of more than 1,000 cu m capacity.

Source: Drewry Shipping Consultants Ltd.

Australian exports to Japan

Shipments of Australian LNG to Japan were scheduled to increase with the maiden voyage late in 1990 of Northwest Snipe, the fourth ship in the North West Shelf Project's planned seven tanker fleet. Gas production to feed the project moves by pipeline from Platform A in North Rankin field off Western Australia.

Northwest Snipe was built at Chiba shipyard of Mitsui Engineering & Shipbuilding. It is the newest in the world fleet of LNG tankers (Table 4).

Partners in the project's LNG phase, each holding a 16⅔% interest, are operator Woodside Petroleum Ltd., BHP Petroleum (North West Shelf) plc, BP Developments Austra-

Table 2

World LNG exporting/importing countries*

EXPORTERS	1986 Volume (bcf)	1986 % of world trade	1987 Volume (bcf)	1987 % of world trade	1988 Volume (bcf)	1988 % of world trade
Indonesia	716.0	39.6	781.2	39.4	868.0	40.6
Algeria	423.8	23.4	495.2	25.0	523.7	24.5
Malaysia	242.3	13.4	282.9	14.3	291.7	13.7
Brunei	246.5	13.6	247.6	12.5	256.0	12.0
Abu Dhabi	103.5	5.7	101.4	5.1	112.3	5.3
U.S.	45.9	2.5	44.5	2.2	45.9	2.2
Libya	30.4	1.7	28.3	1.4	37.4	1.8
Total	**1,808.5**	**100.0**	**1,980.8**	**100.0**	**2,135.1**	**100.0**
IMPORTERS						
Japan	1,346.9	74.5	1,388.2	70.1	1,479.7	69.3
France	270.9	15.0	330.5	16.7	316.1	14.8
Spain	87.6	4.8	87.9	4.4	114.8	5.4
Belgium	91.5	5.1	100.6	5.1	101.7	4.8
South Korea	5.3	0.3	69.2	3.5	94.3	4.4
U.S.	2.1	0.1	—	—	20.1	0.9
Italy	—	—	—	—	6.7	0.3
U.K.	—	—	—	—	1.8	0.1
West Germany	4.2	0.2	4.2	0.2	—	—
Total	**1,808.5**	**100.0**	**1,980.8**	**100.0**	**2,135.1**	**100.0**

*Totals may not add due to rounding.
Source: American Gas Association from Cedigaz data

The three phase GdF contract, worth $176.6 million, covered the Skikda GL1-K LNG complex in eastern Algeria.

In the first phase Sofregaz will conduct a technical assessment of what needs to be done. In the second phase Sofregaz will return the unit to its original 275.4 bcf/year capacity during 1991-92. And in the final stage of the contract, capacity will be increased to 350 bcf/year in 1994.

The Bechtel contract covered a 1 year technical audit and subsequent engineering/construction management for the 370.8 bcf/year, six train, GL1-Z plant at Bethioua.

Bechtel estimated the project could require 4 years, but the time will depend on how much renovation will be needed.

Bechtel built the plant in the late 1970s.

Kellogg will revamp Arzew GL2-Z, which also has a design capacity of 370.8 bcf/year. The three phase project called for a detailed audit in the first phase to determine the scope of work to be included in the second and third phases, which are renovation and production enhancement with related training and improvement of systems, procedures, and organization for operation.

Kellogg's contract required multinational financing, which was being developed jointly by Sonatrach and Kellogg.

GdF Pres. Francis Gutmann said the Sonatrach contract was in line with the trend of developing partnerships between gas suppliers and customers worldwide. The French company offered 100% financing for its engineering contract.

In addition, Algeria was consulting GdF on the first stage of its proposed Algeria-Morocco-Spain gas pipeline in which France was not involved.

GdF also had 12 joint venture agreements under negotiation with the Soviet Union, its second largest gas supplier, involving gas transmission and distribution systems, as well as manufacture of equipment.

Gutmann said the Soviet Union might not be able to maintain its export volumes long term because of rapidly growing internal demand.

Nigerian LNG is the best prospect for future supply, he said. GdF is lined up to take 17.6 bcf/year from the first phase of the Nigerian project. Increased liftings will depend on prices.

Nigeria's LNG project advances

Nigeria's plans for an LNG export project took a big step forward in September 1990 when the U.S. Maritime Administration (Marad) and several companies agreed to settle a dispute centering on ownership and sale of three LNG tankers.

The aim of the project, to cost more than $2.5 billion, is to export about 4 million metric tons/year of LNG.

Marad's agreement covering the Arzew, Southern, and Gamma vessels was struck with units of Royal Dutch/Shell, Argent group, and Cabot Corp. Marad acquired the tankers by repossession from subsidiaries of El Paso Corp.

Here are key provisions of the settlement:

- All litigation among the parties was to be dismissed with prejudice.
- Gamma was to be sold to Cabot, which planned to charter it to Nigeria LNG Ltd. on a half-yearly basis after start-up of Nigerian LNG exports. Cabot was to have free use of the tanker at all other times. It planned to use the vessel for LNG shipments to the U.S. from Algeria and Nigeria.
- Arzew and Southern were to be sold to Argent, which planned to charter them to Shell.
- Total purchase price paid to Marad for each vessel was to be $18.1 million, including option fees previously paid to Marad.
- The vessels were to undergo refurbishment in U.S. shipyards and receive maintenance and repairs in the U.S.
- The vessels were to be dedicated to LNG trade between the U.S. and other countries.

The following October, Energy Transportation Group Inc. (ETG), New York, filed a federal lawsuit to block Marad's sale of the tankers. But U.S. Transportation Sec. Samuel Skinner denied ETG's request to review the sale agreement, and a federal district court judge declined to block the deal and dismissed ETG's suit.

The suit claimed Marad's sale agreement violated terms of the agency's original bid solicitation. The ETG suit also alleged several improprieties by Marad in reaching its accord with Argent, Cabot, and Shell.

Table 3

Japan's LNG sources

	Japan's imports 1988	Suppliers' export capacity 1988	1995	2000
	Million tons/year			
Alaska, Cook Inlet	1.0	1.0	1.0	1.0
Alaska, North Slope*	—	—	8.0	8-14
Australia	1.6	1.6	6.0	6.0
Abu Dhabi	2.2	2.2	4.3	4.3
Brunei	5.1	9.1	5.1	4.0
Malaysia	6.0	10.0	10.0	10.0
Indonesia	15.0	18.5	28-29	28-29
Total†	**31**	**42**	**62-63**	**61-68**
Forecast for 1995	38			
Forecast for 2000	46			
Forecast for 2010	57			

*Yukon Pacific project. †Total and forecasts rounded.

Source: Geopolitics of Energy

ETG's suit charged that terms under which Argent and Cabot agreed to buy the vessels violated Marad's original bid solicitation in part because Argent, although a separate entity from Shell, was simply acting as Shell's agent for the deal.

Royal Dutch/Shell in 1988 purchased an exclusive option to buy the LNG carriers, but federal law required the vessels to be sold to a U.S. citizen. Shell nominated Argent to be the U.S. citizen buyer in the deal.

The project's drive to assemble a fleet of LNG tankers got a boost in June 1990 when Nigeria LNG disclosed the purchase of two laidup LNG vessels. But until LNG shipments to Europe and North America start in 1995 the French built vessels Gastor and Nestor, each of 122,000 cu m capacity, were to be time chartered for use in the trans-Atlantic LNG trade.

The vessels, laid up since they were built in 1977, were purchased by Enellengee Ltd., a subsidiary of Nigeria LNG Ltd., using a loan under which it also had acquired two Swedish built LNG carriers in January 1990.

Nigeria LNG Ltd. was a partnership of project sponsors Nigerian National Petroleum Corp. 60%, Shell Gas 20%, and Agip SpA and Ste. Nationale Elf Aquitaine 10% each.

Nigeria LNG in 1989 let a contract to a combine of Technip and M.W. Kellogg Co. for project specification preparation for a liquefaction plant in Rivers State.

Norway again a possibility

Norway's state owned Den norske stats oljeselskap AS (Statoil) disclosed in October 1990 that negotiations were about to begin for the sale of LNG from offshore arctic Norway to ENEL, Italy's national electrical power company.

Statoil, which earlier in the year dropped its plans for LNG exports to the U.S. based on supplies from the North Sea, said ENEL was interested in LNG purchases based on Snohvit field on the Tromsoflaket.

The field, on the western edge of the Barents Sea in 900-1,110 ft of water, has 3.5 tcf of reserves and is capable of supplying an 8 billion cu m/year LNG export project. Negotiations with ENEL were to center on a project of 4-5 billion cu m/year.

ENEL was the second Italian state company negotiating for Norwegian gas. SNAM, part of the ENI group, was still talking to Statoil as head of a Norwegian gas negotiating group for as much as 5 billion cu m/year from the North Sea delivered to Northwest Europe through existing pipelines.

Talks for increased volumes of North Sea gas coincided with approaches from Algeria and Libya to boost deliveries from North Africa to Italy through proposed increased pipeline capacity under the Mediterranean.

Portugal's Petrogal also voiced interest in Norwegian LNG as supply for a natural gas grid proposed to link Lisbon with Oporto, Braga, and Coimbra.

Petrogal, in partnership with the Portuguese tanker company Soponata, Enagas of Spain, and SNAM of Italy, planned to build an LNG import terminal near Lisbon.

Petrogal said Algeria and Norway are under consideration as the source for 2-3 billion cu m required for the initial import supply.

In April 1990, Statoil disclosed it had dropped the proposal for a 2.5 billion cu m/year LNG export project based on gas from the Norwegian North Sea. The gas would have been sold to the U.S. through an agreement between Enron Corp. and Statoil.

Statoil said geological complexities in South Gullfaks field, the proposed supply source, and improved prospects for selling North Sea gas in Europe were responsible for the decision.

Venezuela's plans taking shape

Venezuela disclosed in June 1990 it had chosen Exxon Corp., Mitsubishi Heavy Industries Ltd., and Royal Dutch/Shell Group to participate in its $3 billion LNG export project.

It marked the first time international oil companies had been involved in an oil or gas project in Venezuela since the country nationalized its oil industry in 1976. Units of Exxon and the Shell group were nationalized.

The three companies were to be partners with Lagoven SA, a unit of state owned Petroleos de Venezuela SA. Tentatively, the interests broke out as Lagoven 32%, Shell 31%, Exxon 29%, and Mitsubishi 8%.

The Cristobal Colon LNG export project called for development of gas discoveries in the Gulf of Paria dating to 1978, installation of a 45 km subsea pipeline, and construction of a processing/liquefaction/tanker loading complex at Mapire Bay between the towns of Guiria and Macuro on Paria Peninsula.

Construction was scheduled to begin in 1992, with exports of 4.4 million metric tons/year of LNG, valued at about $500 million/year, to begin in 1996. Most LNG exports were expected to go to the U.S.

Plans called for Lagoven to drill 55 wells from four to eight platforms. From them, gas will move through the subsea pipeline to the complex on Mapire Bay

Pdvsa broke out project costs as about $1 billion for the platforms, wells, and pipeline, $1.3 billion for the processing/LNG complex, and $600 million for three LNG tankers. It was not immediately clear whether LNG carriers will be purchased or chartered for the project.

With wells producing an average 13 MMcfd, Pdvsa said it expected the Gulf of Paria fields to produce for 20 years. Pdvsa also said believed the project will be economic with oil prices at $20/bbl.

Because of the nationalization law, the project required approval by Venezuela's Congress.

LNG supplies from Alaska

Two events in 1990 heralded a buildup in LNG shipments from Alaska:

- In November, Yukon Pacific Corp., Anchorage, Alas., let contract to Bechtel Corp., Houston, for design of the first phase of its proposed gas liquefaction plant and marine terminal at Anderson Bay, Alas., near Valdez. It is to be part of Yukon Pacific's Trans-Alaska Gas System (TAGS) project to export LNG to Japan, South Korea, and China. Yukon Pacific said the plant will be the largest of its kind when all

Current chains in world LNG trade*

No.	Chain	Loading ports	Unloading ports	Distance (miles)	Tankers in operation
1	Algeria-U.K.	Arzew	Canvey Island	1,556	Methane Princess
2	Algeria-France	Arzew	Le Havre	11,428	Hassi R'Mel
		Skikda	Le Havre	1,780	
3	Algeria-France	Arzew	Fos sur Mer	526	Hassi R'Mel
		Skikda	Fos sur Mer	398	Tellier
					Descartes
					Snam Palmaria
4	Libya-Italy	Marsa el Brega	La Spezia	969	Snam Palmaria
5	Libya-Spain	Marsa el Brega	Barcelona	1,068	Laieta
					Snam Palmaria
					Snam Elba
					Havfru
					Isabella
6a	Algeria-Spain	Arzew	Barcelona	355	Isabella
		Skikda	Barcelona	349	Annabella
					Snam Elba
					Havfru
					Laieta
					Descartes
6b	Algeria-Spain	Arzew	Huelva	373	Annabella
		Skikda	Huelva	718	Isabella
					Cinderella
					Havfru
7	Alaska-Japan	Kenai	Negishi	3,240	Polar Alaska
					Arctic Tokyo
8	Brunei-Japan	Lumut	Negishi	2,380	Bebatik
			Sodegaura		Bekalang
			Senboku		Bekulan
					Belais
					Bilis
					Belanak
					Bubuk
9	Abu Dhabi-Japan	Das Island	Futtsu	6,425	Norman Lady
			Sodegaura		Hilli
					Gimi
					Khannur
					Golar Freeze
10	Indonesia-Japan	Bontang	Chita	2,400	LNG Aquarius
			Senboku		LNG Aries
			Himeji		LNG Capricorn
			Tobata		LNG Gemini
		Blang Lancang	Chita	3,200	LNG Leo
			Senboku		LNG Libra
			Himeji		LNG Taurus
			Tobata		LNG Virgo

phases are complete.

- In July, Phillips 66 Natural Gas Co. and Marathon Oil Co. signed a contract with Ishikawajima-Harima Heavy Industries Co. Ltd. (IHI), Tokyo, to build two LNG tankers. The new vessels will replace Phillips-Marathon's Arctic Tokyo and Polar Alaska LNG tankers, currently in service to contract customers in Japan.

In March 1990, Yukon Pacific Corp. disclosed it had signed a memorandum of intent to sell Korea Gas Corp. 2 million tons/year of Alaskan North Slope gas beginning in 1997.

The preceding November the U.S. Department of Energy approved Yukon Pacific's proposal to export the gas to Pacific Rim nations. DOE later affirmed that decision when it denied a rehearing request by Alaskan Northwest Natural Gas Transportation Co. and Foothills Pipe Lines (Yukon) Ltd.

They were sponsors of the Alaskan Natural Gas Transportation System (Angts) project to move Alaskan North Slope gas to the Lower 48 states.

Angts sponsors have built the southern third of their pipeline system but not a trunk line to move gas from the North Slope to Alberta, where the present system starts.

Yukon Pacific's $11 billion TAGS project included a chilled 800 mile pipeline paralleling the trans-Alaska crude oil line from the North Slope to Alaska's southern coast, a terminal and liquefaction plant at Anderson Bay, and LNG tankers. Completion target is 1996.

Alaska and the U.S. Interior Department granted rights-of-way for the pipeline, and a final environmental impact statement was been prepared.

William McHugh, Yukon Pacific president and CEO, said, "The leadership position taken by South Korea provides the TAGS project with the momentum we need to move forward in conducting negotiations with other market countries.

"South Korea is the second largest market we targeted. The memorandum is a tremendous endorsement of our proposal.

"We are working to obtain similar expressions from Japan and Taiwan."

McHugh said the project will provide the U.S. with an estimated $80 billion in trade revenues during 25 years.

He said, "Far East demand for LNG is expected to increase more than 60% by 2000. TAGS is one of the few

Table 4

No.	Chain	Loading ports	Unloading ports	Distance (miles)	Tankers in operation
11	Algeria-U.S.	Skikda	Everett	3,634	Mostefa Ben Boulaid Bachir Chihani Larbi Ben M'Hidi Mourad Didouche Louisiana
12	Algeria-France	Arzew Skikda	Montoir de Bretagne Montoir de Bretagne	1,257 1,619	Ramdane Abane Edouard L.D. Tellier Hassi R'Mel
13	Malaysia-Japan	Bintulu	Sodegaura Higashi-Oghishima Futtsu	2,480	Tenaga Satu Tenaga Dua Tenaga Tiga Tenaga Empat Tenaga Lima
14	Indonesia-Japan	Blang Lancang	Niigata Higashi-Ohgishima Futtsu	3,530	Echigo Maru Kotowaka Maru Dewa Maru Wakaba Maru
15	Indonesia-Japan	Bontang	Chita Senboku Himeji Yokkaichi	2,400	Bishu Maru Banshu Maru Senshu Maru
16	Indonesia-Korea	Blang Lancang	Pyeong Taek	3,100	Golar Spirit Hoegh Gandria
17	Indonesia-Japan	Bontang Blang Lancang	Yokkaichi Yokkaichi	2,400 3,200	Asake Maru
18	Algeria-Belgium	Arzew	Zeebrugge	1,550	Methania Mourad Didouche
19	Australia-Japan	Withnell Bay	Sodegaura Chita Himeji Yanai Oita Senboku	3,670	NW Sanderling NW Swift NW Swallow
20	Algeria-Spain	Arzew Skikda	Cartagena Cartagena	113 387	Annabella Isabella Cinderella Havfru
21	Algeria-U.S.	Arzew	Lake Charles	4,962	Louisiana Mostefa Ben Boulaid
22	Algeria-Japan	Arzew	Sodegaura Senboku	9,179	Bachir Chihani

*As of May 1990.

Source: Institute of Gas Technology from data compiled by Groupe International des Importateurs de Gas Natural Liquefie

projects in the world able to satisfy such a large demand and the only U.S. project capable of achieving such dramatic reductions in our trade deficit."

The new Phillips-Marathon tankers will use IHI's SPB product containment system, which is a self-supporting prismatic tank built of aluminum.

Among the advantages of the design are greater safety, easier maintenance, and better maneuvering ability, Phillips said.

Each of the carriers is to have a capacity of 87,500 cu m of LNG, compared with only 71,500 cu m each for the Arctic Tokyo and Polar Alaska tankers they will replace. The two present tankers have been carrying LNG from Kenai, Alas., to Tokyo since 1969.

The first tanker is to be delivered in mid-1993, the second at yearend 1993.

Phillips-Marathon customers are Tokyo Electric Power Co. Inc. and Tokyo Gas Co. Ltd.

Phillips operates the liquefaction plant on Alaska's Kenai Peninsula, while Marathon operates the tankers. Phillips holds a 70% interest in the sales and facilities, Marathon a 30% interest.

U.S. terminal scheduled to reopen

Along the Chesapeake Bay in southern Maryland is a multimillion dollar investment Columbia Gas System wants to turn profitable.

A partnership of Columbia LNG and Shell Oil Co. plans to reopen Columbia's mothballed Cove Point, Md., LNG terminal. The $300 million, 1 billion cfd terminal is linked to a Columbia trunkline in northern Virginia by an 87 mile, $400 million pipeline with the same capacity.

Columbia and Consolidated Natural Gas Co. received the first shipment at the 1 billion cfd plant in March 1978, but shipments were suspended in April 1980 in a dispute over gas price. Columbia became sole owner in April 1988 after CNG walked away from its part of the investment.

The new Cove Point Trading partnership expected to sign purchase agreements for Algerian and Nigerian LNG before yearend 1990, enabling Columbia to reopen Cove Point by early 1993 if regulatory permits are issued.

A major stumbling block was removed when Marad agreed to the sale of three LNG tankers.

After LNG supply contracts were signed, Columbia LNG

IEA/OECD stocks on land

	Aug. 1, 1990	Nov. 1, 1990		
	Total stocks	Company stocks	Government stocks	Total stocks
Canada	15.8	15.2	—	15.2
U.S.	213.7	127.8	79.5	207.2
North American	**229.5**	**143.0**	**79.5**	**222.4**
Australia	5.0	4.1	—	4.1
Japan	77.1	49.3	28.2	77.5
New Zealand	1.0	0.9	—	0.9
Pacific	**83.1**	**54.4**	**28.2**	**82.6**
Austria	2.7	2.4	0.3	2.7
Belgium	4.7	4.3	—	4.3
Denmark	4.8	2.6	1.9	4.5
Germany	39.4	12.4	25.9	38.4
Greece	4.2	3.9	—	3.9
Ireland	1.1	1.2	—	1.2
Italy	21.4	21.5	0.8	22.3
Luxembourg	0.3	0.3	—	0.3
Netherlands	9.9	7.1	2.3	9.4
Norway	4.0	4.0	—	4.0
Portugal	2.8	3.0	—	3.0
Spain	9.8	9.3	—	9.3
Sweden	6.6	6.1	0.2	6.4
Switzerland	5.7	5.8	—	5.8
Turkey	3.4	3.3	—	3.3
U.K.	17.4	17.1	—	17.1
IEA Europe	**138.2**	**104.5**	**31.4**	**135.9**
IEA	**450.9**	**301.8**	**139.1**	***440.9**
Iceland	—	—	—	—
Finland	3.4	—	—	3.4
France	20.5	—	—	20.2
Total OECD	**474.9**	**—**	**—**	**464.5**

*Total stocks of 440.9 million metric tons are the equivalent of 150 days of net imports.

Effect on Japan

The embargo touched off a scramble for supplies among oil importing nations.

Japan was the biggest lifter of Iraqi crude, but initially Japan's government and oil companies were more concerned about the possible effect of higher crude and product prices on inflation than a supply shortage.

That confidence was based on high levels of strategic crude stocks in Japan. After the supply crises of the 1970s, the Japanese government pledged to introduce its own strategic reserves and started stockpiling in 1978 through Japan National Oil Co.

In August 1990 Japanese strategic stocks were 520 million bbl, some 197 million bbl government held and 322 million bbl in private storage. Japan's stocks were equal to 142 days of consumption and compare with stocks of only 50 days' consumption in the mid-1970s.

Japanese companies had been lifting about 220,000 b/d from Iraq and had contracts for about 150,000 b/d from Kuwait, together totaling about 12% of its oil supplies.

Buyers tried to replace some of the shortfall from Iran. Early in 1990 it had bought 290,000-300,000 b/d from Iran, but it had fallen to 230,000 b/d at the time of the invasion.

Abu Dhabi withdrew an earlier decision to cut Japanese liftings and supplied Japan 220,000 b/d. The earlier cut was spurred by U.A.E.'s efforts to cut its production to 1.5 million b/d in line with OPEC's July agreement on production and pricing.

Japan decided to release its national strategic oil reserve for the first time. It had stocks totaling about 142 days' consumption but the Japan Petroleum Federation said a 60 day reserve was adequate.

Early in 1991 Japan's Ministry of Trade and Industry reduced local oil companies' requirements to hold stocks to 78 days' consumption from 82 days to meet its IEA requirement for a 350,000 b/d release of crude.

Eastern Europe

Iraq's invasion of Kuwait has transformed eastern Europe's critical liquid fuel shortage into a pervasive financial catastrophe.

Higher crude prices cut deeply into Polish, Czechlovakian, and Bulgarian export revenues.

With Soviet oil deliveries to eastern European nations drastically reduced, those countries had turned to Iraq for crude. But the embargo against Iraq prevented either delivery of oil already contracted for or payments on the $5 billion debt that Baghdad owed eastern European countries.

Bulgaria was hardest hit. Iraq owed Bulgaria $1.2 billion, was receiving no Iraqi oil, and lost $160 million in embargoed exports to Iraq and Kuwait.

Iraq owed Yugoslavia $1.5 billion, with Belgrade expecting repayment in crude. Not only did Iraq crude deliveries stop, but Yugoslavia was unable to export $1 billion in goods

What U.S. refiner/marketers did after Mideast war started*

Company	Supply action	Price action	Time frame
American Petrofina	None	Reduced wholesale gasoline 18-13¢/gal	Jan. 18 until further notice
Amoco	None	Froze wholesale gasoline and posted jet fuel and distillates, rescinded planned Jan. 17 price hike	Jan. 17 until further notice
ARCO	None	Froze gasoline, diesel and jet fuel	Jan. 16, with Jan. 23 review
Ashland	Supplying at least 100% of product needs; continuing "equitable" allocation system	None	NA
BP America	On West Coast only, 50% of January 1990 allocations	None	Jan. 15-31
Chevron	None	Capped wholesale prices for all branded products and froze pump prices at all 680 company owned stations, then cut wholesale branded prices by as much as 5¢/gal for gasoline and as much as 9¢/gal for diesel	Freezes Jan. 16, cuts Jan. 18, freezes lifted Jan. 23
Citgo	None	None	NA
Coastal	None	None	NA
Conoco	Allocating 100% of historic supply to wholesale customers	Reduced gasoline 6-8¢/gal, diesel fuel 8-10¢/gal	Jan. 17 until further notice
Crown Central	Allocation program if necessary	Reduced wholesale gasoline, heating oil at Crown distribution terminals in eastern U.S., at La Gloria division terminals in Tyler, Tex., and U.S. Midwest	NA
Exxon	None	Reduced wholesale prices in U.S. by 5¢/gal for branded gasoline and 10¢/gal for distillates	Jan. 17
Marathon	For branded products, allocating 100% of contract monthly and 150% of daily limits; other wholesale products, 150% of daily limits	None	Jan. 16 until further notice
Mobil	Started ratable lifting program for gasoline and heating oil; liftings restricted to 100% of contract entitlements	Froze all petroleum products prices	Jan. 16 until further notice.
Phillips	Distributing motor fuel and distillates each day in amount equal to montly contracts divided by business days in the month	Increased wholesale supply management surcharge to 25¢/gal from 10¢/gal for motor fuel and distillates	Jan. 14
Shell	Supplying 100% or normal requirements	Froze prices for gasoline, aviation fuel, heating oil, lubricants, and other light products	Jan. 16 until further notice
Sun	None	Reduced unbranded product prices "substantially;" froze Sunoco and Atlantic gasoline prices to all classes of customers	Jan. 17 until further notice
Tesoro	None	None	NA
Texaco	None	Froze branded wholesale	Jan. 17 until further notice
Unocal	None	Capped all product prices in West and Southeast U.S. and at all U.S. truck stops	Jan. 16 until further notice

* As of Jan. 23. Frozen prices in some instances are considered ceiling prices.

ordered by Iraq.

Faced with unexpected cuts in Soviet oil deliveries, Hungary also turned to Iraq for oil as payment on Baghdad's $150 million debt to Budapest.

Hungary, Bulgaria, Czechoslovakia, Poland, and Romania were operating their refineries far below capacity because of crude shortages.

Kuwaiti refineries damaged

In January 1991 Iraqi artillery rounds set a storage tank afire at the Japanese owned Arabian Oil Co.'s Ras al Khafji 30,000 b/d refinery in the Saudi sector of the Neutral Zone.

The refinery at Khafji apparently not damaged by the fighting around the town because Iraqi forces never reached the southern side of the city, where the oil installations are located.

The unit had been shut down as a precautionary measure. The smallest refinery bordering the Persian Gulf, it was not a major contributor to exports or the war effort.

An Iraqi strike into Saudi territory and the battle at Khafji forced Saudi Aramco to halt production from Safaniyah, Zaluf, and Marjan offshore fields, cutting total output by about 25% to 6 million b/d.

The platforms serving the three fields remained fully manned during the battle and were undamaged. Production was resumed a few days later. The shutdown did not affect Ras Tanura or Juaymah liftings because of huge Saudi crude stocks.

Iraqi forces also set fire to storage tanks at the 190,000 b/d Mina Abdulla and 187,000 Shuaiba refineries on the coast. Kuwait's three extremely sophisticated refineries at

U.S. single hull phaseout calendar*

Fig. 4

1995		40	40	28
1996		39	38	27
1997		38	36	26
1998		37	34	25
1999		36	32	24
2000		35	30	23
2001	Exempt until 2015	35	29	23
2002		35	28	23
2003		35	27	23
2004		35	26	23
2005		25	25	23
2006		25	25	23
2007		25	25	23
2008		25	25	23
2009		25	25	23
2010				
2011				
2012				
2013				
2014				
2015				

Must have double hull

Must have double containment system

* In all cases, vessels with double bottoms or double sides are allowed an extra 5 years to comply. Source: American Bureau of Shipping

vessel. And reports from Japan said shipbuilders wanted to boost prices even further with the target of $100 million/vessel.

Strongest growth in orders for new tankers occurred during the first 3 months of the year. But the momentum was not fully maintained into the second quarter, and the June order book was slightly thinner than in the previous month. Industry sources said it was too early to attribute a small decline in June orders to high construction prices.

Of greater interest to the industry was the attitude of tanker owners who had not yet joined the ordering spree but will need to replace part of their fleet during the 1990s.

The Royal Dutch/Shell Group, one of the largest oil company owners, made its position clear on tanker construction.

It said there is no case on economic grounds for a VLCC replacement program. And in the short term, shipyard capacity does not exist to handle a major replacement program that could flow from likely demand for 150-200 new VLCCs and ultralarge crude carriers (ULCCs) by 2000 (Fig. 2).

Shell figured that to earn even a modest 8% return on a $90 million investment in construction of a new tanker, a charter rate of about $35,000/day would be needed. That compared with averages of $10,000-15,000/day in recent years. Shell expected rates to average about $20,000/day during 1990.

Instead of newbuildings, Shell planned to extend the life of its VLCCs. The company contended the age of a vessel is not relevant in an assessment of its reliability—if effective maintenance and repair programs are followed.

In making the case for extending the life of VLCCs, Shell said closure of many shipyards in the previous decade reduced construction capacity to 15 million dwt/year. Not every yard can build VLCCs, so the upper limit of larger tanker production probably is nearer 10 million dwt/year.

Replacing 80 million dwt of existing VLCC capacity would take 8 years if all yards capable of doing so built nothing but VLCCs.

But in practice, there are other demands on shipbuilding capacity from buyers of bulk carriers, container ships, and cruise ships. And because it is impossible to replace all older VLCCs with new ships quickly, their continued use for many years is inevitable.

A background of rising rates

The surge in tanker orders took place against a background of rising short term freight rates.

The tanker industry benefited from the Organization of Petroleum Exporting Countries' unofficial policy of maintaining high production levels throughout the second quarter of the year when liftings traditionally decline.

The effect on freight rates for VLCCs was startling. Rates shot up to $21,000/day on average for first half 1990, a 233% gain from the $9,000/day in first half 1989.

Increases for medium sized vessels were substantial but less dramatic.

The first half 1989 average of $13,000/day grew to $17,000/day in the same period of 1990, an increase of 31%.

Rates for product carriers in the 30,000-35,000 dwt range were unchanged at $10,000/day, while there was a small increase in rates for large product carriers from $14,000-15,000/day in first half 1989 to $16,000-17,000/day during the first 6 months of 1990.

OPEC's production policies also were reflected in the amount of tonnage used for floating storage.

At the start of 1990 there were only 46 vessels with a combined 8.5 million dwt operating as floating storage, the lowest level since the early 1980s. But by June 1 the number of storage tankers had grown to 68 with a combined 15.5 million dwt, the highest level since the middle of 1987.

Tanker demand to surpass newbuilding

Long term growth in tanker demand will outstrip newbuilding, Overseas Shipholding Group Inc. (OSG), New York, predicted in mid-1990.

With current orderbooks full, OSG's 1989 annual report projected delivery delays of as much as 3 years on orders for new tankers. "In this environment," it said, "trading conditions for modern, efficient tankers should improve over the next few years."

Considering the large tanker surpluses of the mid-1970s, soft freight rates for very large crude carriers, and increased building activity, a tanker supply crunch may seem unlikely.

But the OSG report outlined four factors in support of its forecast: increased production by members of the Organization of Petroleum Exporting Countries, increased non-Communist oil consumption, decreased worldwide shipyard capacity, and an aging international tanker fleet.

Because of falling scrappings rates and high construction and resale prices, OSG said it believed two thirds of the world tanker fleet will be at least 15 years old by early 1995 if the present newbuildings rate remained constant and scrapping rate was zero.

There is no reason to believe there will be any short term increase in the number of vessels scrapped as long as building and resale prices remain high, OSG said. In fact, the 1989 scrappings rate fell to less than 2 million dwt, the lowest since 1974 (Fig. 3).

In the long run, however, scrappings should begin to surge after 1995, OSG said. Older vessels will begin to need frequent, costly repairs and renewals to comply with insurance and safety regulations. Such demands will make them more expensive to maintain and operate than more modern tankers.

At some point, OSG said, economic considerations require older tankers to be scrapped. Growing worldwide concerns for tanker safety and environmental protection are likely to speed retirement of substandard tonnage.

Tanker newbuilding figures appeared, at first glance, to be encouraging to shippers. Deliveries in 1989 were 9 million dwt, the highest rate since 1978, and another 9 million dwt were on line for delivery in 1990.

In addition, non-Communist tanker fleet capacity rose by 7 millon dwt to 239 million dwt in 1989. But that barely kept up with demand.

Non-Communist oil consumption was up 2.2%, and oil supply, bolstered by steady increases in OPEC production, increased 2.6% in 1989.

Table 1

Breakout of 1989 interregional trading*

	Imports		Exports	
	Crude	products	Crude	products
	1,000 b/d			
U.S.	5,778	2,241	130	687
Canada	358	160	625	319
Latin America	756	448	2,285	1,226
Western Europe	7,475	1,909	493	837
Middle East	10	48	11,678	1,711
North Africa	1	120	1,878	537
West Africa	10	77	2,144	175
East, South Africa	416	42	29	5
South Asia	430	269	33	42
Other Asia†	1,833	869	1,005	678
Japan	3,582	967	—	59
Australasia	190	138	128	90
U.S.S.R., Eastern Europe, China	1,106	186	1,728	1,750
Destination unknown§	211	642	—	—
Total	**22,156**	**8,116**	**22,156**	**8,116**

*Excludes bunkers and intraregional shipments—between individual countries in western Europe and between Alaska and the U.S. Lower 48, for example. †Excludes China and Japan. §Includes things like transit losses, minor shipments not otherwise listed, and unidentified military use.

Source: British Petroleum Co. plc

U.S. oil spill liability law

The legislation Bush signed increased shipowners' liability for spills in U.S. waters from the former $150/vessel ton to $1,200/vessel ton. Owners of the crude are not jointly liable for spills.

Minimum liabilities are $10 million for vessels larger than 3,000 gross tons and $2 million for smaller vessels. Previous federal laws capped liability at $14 million.

Liability for offshore facilities was set at $75 million plus unlimited removal costs. Onshore facilities or deepwater ports would be liable for $350 million in damages. There are no liability limits if a spill results from a spiller's gross negligence, willful misconduct, or violation of a federal operating or safety standard.

The law uses an existing 5¢/bbl fee on oil to build a $1 billion oil spill cleanup fund, half of which can be used for a single spill. Oil spill victims can draw from the fund when the spiller's liability limit has been reached, the spiller is unknown, or settlement is delayed.

The new law requires double hulls on most oil tankers operating in U.S. waters under a timetable based on the vessel's age and gross tonnage (Fig. 4).

Exceptions included the delivering vessel in a lightering operation and tankers calling at Louisiana Offshore Oil Port (LOOP), both until 2015.

The law also requires improved spill response and preparedness. The federal government will direct cleanup of all major spills.

Congress voted not to have the U.S. join a pair of international oil spill liability and compensation agreements because they would preempt more stringent federal and

Table 2

Breakout of world VLCC, ULCC fleet by age and size

	SIZE GROUP							
	200,000-254,999		255,000-319,000		320,000 +		Total	
Year built	No. of vessels	dwt	No. of vessels	dwt	No. of vessels	dwt	No. of vessels	dwt
1969	1	206,972	. . .	. . .	. . .	. . .	1	206,972
1970	3	700,504	1	280,420	. . .	. . .	4	980,924
1971	7	1,563,645	3	795,062	. . .	. . .	10	2,358,707
1972	14	3,322,494	7	1,824,463	. . .	. . .	21	5,146,957
1973	22	5,131,703	17	4,610,579	. . .	. . .	39	9,742,282
1974	26	6,191,366	48	13,071,005	3	1,018,270	77	20,280,641
1975	29	6,877,935	45	12,410,869	9	3,400,242	83	22,689,046
1976	16	3,777,487	40	11,017,444	17	6,624,112	73	21,419,043
1977	3	694,705	12	3,379,663	14	5,584,239	29	9,658,607
1978	2	451,469	3	796,797	7	2,774,287	12	4,022,553
1979	. . .	. . .	4	1,133,059	4	1,898,316	8	3,031,375
1980	. . .	. . .	1	275,271	1	355,020	2	630,291
1981	2	474,998	1	267,672	1	355,020	4	1,097,690
1982	. . .	. . .	1	290,084	. . .	. . .	1	290,084
1983	. . .	. . .	2	603,313	. . .	. . .	2	603,313
1984	1	234,733	. . .	. . .	. . .	. . .	1	234,733
1985	2	490,006	. . .	. . .	. . .	. . .	2	490,006
1986	9	2,150,286	1	317,353	. . .	. . .	10	2,467,639
1987	5	1,170,334	1	259,992	. . .	. . .	6	1,430,326
1988	10	2,458,104	. . .	. . .	. . .	. . .	10	2,458,104
1989	3	748,903	. . .	. . .	. . .	. . .	3	748,903
Total	**155**	**36,645,644**	**187**	**51,333,046**	**56**	**22,009,506**	**398**	**109,988,196**

Source: Clarkson Research Studies, London speculative 3D seismic surveys in shallow and deep waters.

An infrastructure of pipelines and drilling and production platforms, as well as ready availability of offshore rigs and related equipment, allowed operators to implement E&D plans on schedule.

Those factors instilled offshore players with enough confidence to plan gulf projects with more ambitious technological requirements.

For example:

- Texaco U.S.A. drilled the first two documented horizontal wells in the gulf.
- Exxon U.S.A. disclosed details of a development plan in Mobile Bay that required a combination of technological achievements.
- Mobil Exploration & Producing U.S. Inc. completed one of the world's longest extended reach offshore wells.

Ultradeepwater exploration continued at a lower level, again paced by Shell Offshore Inc. BP Exploration Western Hemisphere moved ahead with plans during the year to plunge into ultradeepwater plays.

But all was not automatic in ultradeepwater plays, as witnessed by the decision of Placid Oil Co. and partners to shut down their floating/subsea drilling and production system in the ultradeep water of Green Canyon Block 29, citing sustainable flow rates too low to justify continuing the project.

A variety of prospects

Still, the variety of gulf prospects was adequate to continue attracting U.S. independents and non-U.S. production companies.

Miocene gas plays in water as much as 400-600 ft deep, Pliocene and Pleistocene oil and gas prospects in water deeper than 400 ft, and deep Jurassic Norphlet gas in shallow water off Alabama offered an array of risks and rewards that fit a host of E&D strategies.

While prospects in ultradeepwater and off Alabama garnered much attention—and a considerable share of investment dollars—most gulf drilling took place in more mature, traditional areas of activity in shallower water in the central and western gulf.

The number of bids decreased for ultradeepwater acerage during gulf area-wide lease sales, partly as a result of a reduced numer of blocks that were available.

Of the 538 central gulf tracts that received bids in Outer Continental Shelf Sale 123, conducted in March 1990 by MMS, 370 were in water less than 600 ft.

In OCS Sale 125 the following August, competition was light for ultradeepwater acreage. Only 48 bids were offered for 46 tracts in the Garden Banks area off Texas, three bids were offered on tracts in Keathley Canyon, and two on Alaminos Canyon tracts.

Technological successes in deeper water

Gulf drilling still is trending toward deeper water. The trend is being led by the search for fields with greater reserves.

Gulf operators are seeing constant innovations with significance in acquisition and processing of seismic data. That trend will continue, particularly the ability to analyze amplitude anomalies.

Innovation also is likely to continue in the way wells are drilled in the gulf, based on improved understanding of developmental and structural concepts.

Several gulf projects during 1990 recorded technological advances.

Amoco Production Co. revealed a world record water depth flow test in the gulf. During a 4 day test, the company's 1 Sidetrack 2 well in 3,492 ft of water on Viosca Knoll Block 957 flowed 22.5 MMcfd of gas and 2,670 b/d of condensate through a $^{48}/_{64}$ in. choke with 2,800 psi average flowing tubing pressure.

Baker Hughes active rig count

	Central gulf	Western gulf
1980	139	72
1981	154	74
1982	137	78
1983	124	48
1984	132	55
1985	129	48
1986	69	19
1987	65	19
1988	88	22
1989	72	22
1990	76	22

At midyear, Texaco claimed the first documented horizontal well in the gulf, a province where highly deviated holes are common.

Texaco's B-12 OCS G-0974 horizontal well on East Cameron Block 265 flowed at a rate of 12.1 MMcfd of gas from a sand at 1,700 ft. The well had a horizontal reach of 670 ft.

Texaco completed a second horizontal well, B-12, from the same platform. That well produced gas at a rate of 7 MMcfd, also from a sand at 1,700 ft.

At year's end, both wells were shut in, awaiting four point tests.

Texaco planned no other horizontal wells from B platform on the block but was working on designs of horizontal programs for other areas of the gulf.

Among other operators, Unocal Corp. was considering drilling horizontal wells in the gulf to improve drainage of old fields in which sands with low resistivity looked to be a promising source of substantial unrecovered reserves.

Other Texaco successes

Early in fourth quarter 1990 Texaco discovered a field about 14 miles off Louisiana in 23 ft of water on South Marsh Island Block 240-241, where it logged about 230 ft of gas pay in 10 sands and 90 ft of oil pay in five sands of Upper and Middle Miocene age.

The deepest pay was about 12,200 ft deep, the shallowest about 7,100 ft.

At yearend the company had drilled the discovery well and two development wells on South Marsh Island 240-241 and had plans to drill another six to 10 development wells on the acreage by the end of third quarter 1991.

Texaco planned to develop the acreage by setting caissons in each block and laying flow lines to a production platform on South Marsh Island 239.

Texaco had production on about 20 blocks in the area, which provided a solid base of knowledge on which to plan development. Many reservoirs delineated on South Marsh Island 240-241 produced on adjacent Texaco acreage, eliminating the need for an extensive test program.

Also during 1990, Texaco drilled a series of 10 exploratory and development wells from a platform installed in August 1989 in 622 ft of water about 90 miles off Louisiana on Green Canyon Block 6.

Before it set the platform, Texaco said, exploratory drilling had identified six shallow Pleistocene gas pay zones. After setting the platform and commencing development drilling, the company found five more, generally deeper Pleistocene oil pays ranging from 3,000 to 8,000 ft deep.

Altogether, pay columns of Green Canyon Block 6 wells average 495 ft of gas and 320 ft of oil.

At the end of 1990, Texaco was producing as much as

Oil and gas completions and footage for Gulf ores

	Oil well completions					Gas well completions				
	Alabama offshore	Gulf of Mexico northern federal waters	Louisiana offshore	Texas offshore	Total Gulf of Mexico	Alabama offshore	Gulf of Mexico northern federal waters	Louisiana offshore	Texas offshore	Total Gulf of Mexico
1980	NA	14	126	6	146	NA	0	206	44	250
1981	NA	4	150	9	163	NA	0	207	72	279
1982	NA	17	113	17	147	NA	10	196	94	300
1983	NA	13	231	21	265	NA	8	124	129	261
1984	0	6	310	2	318	1	1	278	75	355
1985	0	7	139	22	168	3	3	150	90	246
1986	0	16	159	10	185	1	2	117	90	210
1987	0	24	163	9	196	1	2	106	35	144
1988	0	13	141	1	155	1	12	113	57	183
1989	0	47	205	13	265	0	28	293	154	475
1990*	0	16	243	28	287	2	10	304	136	452

	Oil well footage					Gas well footage				
	Alabama offshore	Gulf of Mexico northern federal waters	Louisiana offshore	Texas offshore	Total Gulf of Mexico	Alabama offshore	Gulf of Mexico northern federal waters	Louisiana offshore	Texas offshore	Total Gulf of Mexico
1980	NA	168,728	1,314,357	43,136	1,526,221	NA	0	2,076,886	415,276	2,492,162
1981	NA	47,329	1,412,245	80,713	1,540,287	NA	0	2,112,923	679,994	2,792,917
1982	NA	183,832	1,117,360	181,734	1,482,296	NA	123,167	1,991,511	824,041	2,939,369
1983	NA	158,276	2,264,523	187,287	2,610,086	NA	91,322	1,430,347	1,189,822	2,711,491
1984	0	56,310	2,952,490	15,953	3,024,753	21,000	10,275	2,658,371	707,151	3,396,797
1985	0	75,900	1,402,400	195,600	1,673,900	64,400	27,400	1,540,400	907,800	2,540,000
1986	0	176,320	1,457,400	96,602	1,730,322	22,390	15,481	1,298,367	998,752	2,334,990
1987	0	260,845	1,534,846	100,091	1,895,782	21,710	21,128	1,168,353	376,961	1,588,152
1988	0	131,995	1,306,788	10,200	1,448,983	22,950	92,953	1,171,555	593,957	1,881,415
1989	0	504,356	1,861,900	126,060	2,492,316	0	254,838	2,915,083	1,499,214	4,669,135
1990*	0	169,057	2,405,389	283,649	2,858,095	5,024	103,962	2,868,221	1,174,527	4,151,734

*1990 well completions and footage through November.

Sources: Rig count — Baker Hughes Inc.
Well completions — American Petroleum Institute

Data provided by Oil & Gas Journal Energy Database.

Plans call for McDermott to install the Auger TLP in 1993.

Sonat Inc.'s George Richardson semisubmersible rig began drilling Auger wells about midyear 1990.

Shell Offshore expects to begin Auger production in late 1993, peaking at 40,000 b/d of oil and 150 MMcfd of gas. Early estimates place ultimate recovery at about 220 million bbl of oil equivalent.

Also in 1990, Shell Offshore completed development drilling from Platform Bullwinkle on Green Canyon Block 65 in 1,350 ft of water. The company expected to start production through permanent facilities late in 1991. Bullwinkle is the world's tallest fixed platform.

Shell Offshore also had a redevelopment program under way on Cognac platform in 1,025 ft of water on Mississippi Canyon Block 194.

Until Bullwinkle was installed in 1988, Cognac held the gulf deepwater platform record.

In 1987, Shell Offshore set the world water depth drilling record with an exploratory well in 7,520 ft of water on Mississippi Canyon Block 657.

Long a leader in ultradeep water in the gulf, in 1987 Shell Offshore drilled no wells in water less than 1,500 ft deep.

More recently, the company has been active at shallow and deepwater sites throughout the gulf. In 1990, it drilled 13 exploratory wells and 75 development wells.

Shell Offshore produces about 123,000 b/d of oil and 987 MMcfd of gas in the gulf. The company holds about 15% of all gulf acreage, and about 37% of all deepwater gulf acreage.

Shell Offshore intended to start production from Fairway field in Mobile Bay during second half 1991. The company made significant progress with development drilling there in 1990.

Shell Offshore said its Yellowhammer gas treatment plant in southern Mobile County will be ready for start-up in time to receive gas from Fairway field.

Placid pullout

Not all news in 1990 involving ultradeepwater Gulf of Mexico activity was positive.

Placid Oil Co. and its partners in April ended operations on the $400 million floating subsea drilling and production project on Green Canyon Block 29. The decision came when the system's 31-4 satellite well in 2,243 ft of water on Green Canyon Block 31 was lost because of downhole equipment failure.

Placid said sustainable flow rates from the few wells drilled at the site weren't enough to justify continuing the program.

When Placid's Green Canyon Block 29 project went on stream Nov. 14, 1988, it launched an era of ultradeepwater development in the gulf. With a flow rate of 2.5 MMcfd of gas, the 31-4 satellite well established the water depth record for gulf production.

The well's rate of production was gradually increased to

152,953 b/d Canadian EOR production. Because of the increase in HC projects to 51 from 42 in 1988, Canadian EOR production increased by 5.8% from the previous survey.

Venezuelan enhanced oil production decreased. OGJ's previous survey showed 44 projects producing 216,360 b/d of enhanced production.

Although the number of projects dropped only by two to 42, EOR production decreased 45% to 118,788 b/d. Three of the largest drops were Bare (F.O.) field from 28,000 to 8,280 b/d, East Tia Juana field L.L. zone from 18,000 to 6,800 b/d, and Bachaquero field from 41,600 to 4,000 b/d.

The response for the Bachaquero field noted that the steam soak activity was being constrained.

Steam projects in the U.S.

Oil production from steam EOR in the U.S. continued a slow decline from the peak reached in 1986 of 468,692 b/d. A 2.7% decline occurred between the 1986 and 1988 surveys, followed by a further decline of 2.5% from 1988 to 1990. Although declining, steam still accounted for 67.8% of all U.S. enhanced oil recovery. The latest rate was 444,137 b/d.

The six reported steam projects that were planned in the U.S. in 1990-91, because of their limited size of 336 acres, will not greatly influence the production decline from steam EOR projects.

Environmental laws inhibited the expansion of steam projects in California.

Crude burned to generate steam has a relatively high sulfur content.

But one positive development that could spur added enhanced oil production was proposed pipelines to move more gas into the steam EOR areas of California. As long as gas remains cheaper than oil, gas should replace much of the crude oil burned in generating steam.

Better steam EOR economics may spur new or expanded development.

Chemical and gas

The hardest hit by low crude oil prices were chemical projects. Of the 91 terminated or completed projects in the

Table 1

U.S. EOR production

	b/d						
	1980	1982	1984	1986	1988	1990	Change from 1988, %
Thermal							
Steam	243,477	288,396	358,115	468,692	455,484	444,137	−2.5
Combustion in situ	12,133	10,228	6,445	10,272	6,525	6,090	−6.7
Hot water	—	—	—	705	2,896	3,985	37.6
Total thermal	**255,610**	**298,624**	**364,560**	**479,669**	**464,905**	**454,212**	**−2.3**
Chemical							
Micellar-polymer	930	902	2,832	1,403	1,509	617	−59.1
Polymer	924	2,927	10.232	15,313	20,992	11,219	−46.6
Caustic/alkaline	550	580	334	185	0	0	—
Surfactant	—	—	—	—	—	20	—
Total chemical	**2,404**	**4,409**	**13,398**	**16,901**	**22,501**	**11,856**	**−47.3**
Gas							
Hydrocarbon miscible/ immiscible	—	—	14,439	33,767	25,935	55,386	113.6
CO_2 miscible	21,532	21,953	31,300	28,440	64,192	95,591	48.9
CO_2 immiscible	—	—	702	1,349	420	95	−77.4
Nitrogen	—	—	7,170	18,510	19,050	22,260	16.8
Flue gas (miscible and immiscible	—	—	29,400	26,150	21,400*	17,300	−19.2
Total gases	**74,807**	**71,915**	**83,011**	**108,216**	**130,997***	**190,632**	**45.5**
Other							
Carbonated waterflood	—	—	—	—	—	—	—
Grand total	**332,821**	**374,948**	**460,969**	**604,786**	**618,403***	**656,700**	**6.2**

*Corrected

Table 2

Active U.S. EOR projects

	Number of projects										
	1971	1974	1976	1978	1980	1982	1984	1986	1988	990	Change from 1988, %
Thermal											
Steam	53	64	85	99	133	118	133	181	133	137	3.0
Combustion in situ	38	19	21	16	17	21	18	17	9	8	−11.1
Hot water	—	—	—	—	—	—	—	3	10	9	−10.0
Total thermal	**91**	**83**	**106**	**115**	**150**	**139**	**151**	**201**	**152**	**154**	**1.3**
Chemical											
Micellar-polymer	5	7	13	22	14	20	21	20	9	5	−44.4
Polymer	14	9	14	21	22	55	106	178	111	42	−62.2
Caustic/alkaline	—	2	1	3	6	10	11	8	4	2	−50.0
Surfactant	—	—	—	—	—	—	—	—	—	1	—
Total chemical	**19**	**18**	**28**	**46**	**42**	**85**	**138**	**206**	**124**	**50**	**−59.6**
Gas											
Hydrocarbon miscible-immiscible	21	12	15	15	9	12	16	26	22	23	4.6
CO_2 miscible	1	6	9	14	17	28	40	38	49	52	6.1
CO_2 immiscible	—	—	—	—	—	—	18	28	8	4	−50.0
Nitrogen	—	—	—	—	—	—	7	9	9	9	0.0
Flue gas (miscible and immiscible)					8	10	3	3	2	3	50.0
Total gases	**22**	**18**	**24**	**29**	**34**	**50**	**84**	**104**	**90**	**91**	**1.11**
Other											
Carbonated waterflood	—	—	—	—	—	—			1	—	—
Grand total	**132**	**119**	**158**	**190**	**226**	**274**	**373**	**512**	**366**	**295**	**−19.4**

U.S., 54 of them were chemical.

Three of those were micellar/polymer, while the rest were polymer. In addition, operators asked that an additional 21 polymer projects be deleted from the OGJ survey.

Because of the infrastructure in the West Texas area, CO_2 EOR remained strong and was expected to grow, judging from the number of planned projects. The infrastructure makes expansion of CO_2 into nearby fields relatively economical. Half of the almost 30,000 b/d increase in enhanced oil production from HC injection projects came from Prudhoe Bay. HC injection is the only EOR process active on the Outer Continental shelf.

Future projects

In the U.S., 34 projects were in planning stages late 1989 through 1992. More than half, 18, were CO_2 projects.

The largest in area, 23,000 acres, was Mobil Oil's planned project in Postle field in Oklahoma's Texas County.

One large project in West Texas was Shell Western E&P Inc.'s expansion of the CO_2 flood in Wasson field's 28,758 acre Denver Unit.

Guide to EOR project tabulations

A. U.S. planned EOR projects by type
B. Planned projects outside U.S. by country
C. Producing Canadian EOR projects
D. Completed, terminated Canadian projects
E. Producing EOR projects outside U.S. and Canada
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G. Producing thermal EOR in U.S.
H. Producing CO_2, gas EOR in U.S.
I. Producing chemical EOR projects in U.S.
J. Completed, terminated U.S. projects
K. Producing Canadian heavy oil EOR projects

Table A

U.S. planned EOR projects by type

Project type	Operator	Field	Location	Pay zone	Size, acres	Depth, ft	Gravity, °API	Start date
CO_2 immiscible	Chevron	Bay Marchand	Offshore Louisiana	Pliocene-Miocene	3 wells	8,500	15-20	6/90
CO_2 miscible	Citronelle Unit	Citronelle	Mobile County, Ala.	Rodessa	1,680	11,000	42	1/90
CO_2 miscible	Conoco	South Huntley	Garza County, Tex.	San Andres	450	3,100	37	1/90
CO_2 miscible	Conoco	Huntley East	Garza County, Tex.	San Andres	700	3,100	37	1/92
CO_2 miscible	Mobil	Postle	Texas County, Okla.	Morrow	23,000	6,100	40	6/91
CO_2 miscible	Mobil	Slaughter	Cochran, Hockley, Tex.	San Andres	4,800	5,000	32	1990
CO_2 miscible	Mobil	Salt Creek	Kent County, Tex.	Canyon	12,100	6,300	39	1990
CO_2 miscible	Mobil	Slaughter	Cochran County, Tex.	San Andres	1,280	4,900	32	1990
CO_2 miscible	Mobil	Levelland	Cochran, Hockley, Tex.	San Andres	12,100	4,800	32	1990
CO_2 miscible	Mobil	Russell	Gaines County, Tex.	Lower Clearfork	4,820	7,500		1992
CO_2 miscible	Phillips	Aneth	San Juan County, Utah	Desert Creek	3,250	5,500	40	1/91
CO_2 miscible	Phillips	Jess Burnes	Reeves County, Tex.	Delaware	100	3,300	36	1/90
CO_2 miscible	Phillips	Leamex	Lea County, N.M.	Paddock	120	6,200	39	2/90
CO_2 miscible	Phillips	Ranger Lake	Lea County, N.M.	Bough C	320	9,000	40	1/90
CO_2 miscible	Phillips	South Cowden	Ector County, Tex.	Grayburg/San Andres	800	4,700	35	1/91
CO_2 miscible	Phillips	Vacuum	Lea County, N.M.	San Andres	320	4,500	37	1/91
CO_2 miscible	Shell	Wasson	Yoakum Co., Tex.	San Andres	9,586	5,200	33	1992
CO_2 miscible	Texaco	Paradis	St. Charles, La.	10,000 feet	102	11,400	38.5	1/90
CO_2 miscible	Texaco	Paradis	St. Charles, La.	Main Pay	89	10,500	37.5	1/90
HC miscible	ARCO	Kuparuk River Unit	North Slope, Alaska	Kuparuk "A" & "C"	40,000	6,200	24	6/90
HC miscible	ARCO	Prudhoe Bay	Alaska		3,200			1990-91
HC miscible	Marathon Oil	Sand Dunes	Converse County, Wyo.	Muddy S.S.	6,400	12,500	40	12/90
HC miscible	Marathon Oil	So. Coles Levee Unit	Kern County, Calif.	Stevens (FI)	40	9,700	34	4/90
Micellar	ARCO	Sabine Tram SW	Newton County, Tex.	Wilcox	2,010	11,525	49	12/89
Microbial	Phillips	N. Burbank	Osage County, Okla.	Burbank	40	2,900	39	6/90
Polymer	Mitchell Energy	Alba	Wood County, Tex.	Sub Clarksville	1,132	4,000	15.5	1990
Polymer	Phillips	N. Burbank	Osage County, Okla.	Burbank	160	2,900	39	3/90
Steam	Bechtel	Shallow Oil Zone	Kern, Calif.	Sub-Scalez	20	2,800	27	1991
Steam	Mobil	Bayou Bleu	Iberville Parish, La.	Miocene	16	11-1,600	16	1/91
Steam	Mobil	Lost Hills	Kern County, Calif.	Etchegoin	80	400	15	1/90
Steam	Mobil	Lost Hills	Kern County, Calif.	Etchegoin	100	400	15	10/90
Steam	Mobil	Saratoga	Hardin County, Tex.	Miocene	20	850	20	1/90
Steam/polymer	Unocal	Brea-Olinda	Orange Co., Calif.	1st-3rd Pliocene	100	3,500	16	2/90
Surfactant	Marathon Oil	Yates	Pecos County, Tex.	San Andres	80	1,500	30	11/89

Table B

Planned projects outside U.S. by country

Type project	Operator	Field	Country	Pay zone	Size, acres	Depth, ft	Gravity, °API	Start date
CO_2 immiscible	Trintoc	Oropouche	Trinidad	Retrench Sand	175	2,160	29	3/90
CO_2 miscible	Pan Canadian	Countess	Canada/Alta.	Glauconite	80	4,000	30	10/90
Combustion	Pan Canadian	Countess	Canada/Alta.	Glauconite	80	4,000	30	7/90
HC miscible	Chevron Canada	Acheson	Canada/Alta.	Leduc D-3	3,810	5,000	39	1991
HC miscible	Esso Res. Canada Ltd.	Boundary Lake Unit #1	Canada/B.C.	Triassic Bound	320	4,300	34	10/90
HC miscible	Mobil Oil Canada	Rainbow Twp 110,R6,W6M	Canada/Alta	Keg River QQ	200	5,300	38	1/91
N_2 miscible	Mobil Oil Canada	Carson Creek North	Canada/Alta.	BHL	4,000	8,799	45	1/91
Polymer	OMV	Matzen	Austria	9th Tortonian	66	4,330	21	7/90
Steam	BEB	Georgsdorf III	West Germany	Valanginian	80	2,100-2,800	27	10/90

Two thirds of the unit was under continuous CO_2 injection. This area was to be converted to a water-alternating-gas (WAG) injection, and the remaining one third of the unit was to be put on continuous CO_2 injection followed by WAG at a later date. Shell's Denver Unit is the largest CO_2 EOR project in the world in terms of production. At the end of 1989 the unit was producing 41,100 b/d, of which 25,300 b/d were considered enhanced recovery.

Internationally only nine projects were planned, six of them in Canada. The largest in area, 4,000 acres, was Mobil Oil Canada's miscible N_2 project in Carson Creek North field of Alberta.

Total planned expenditures through 1992 on these projects is estimated to be $502 million.

Producing Canadian EOR projects

					– Number wells –					
Operator	Field	Province	Start date	Area, acres	Prod.	Inj.	Pay zone	Formation type	Porosity, %	Permeability, md
Alkaline										
Amoco Canada*	Cessford	Alta.	7/84	680	19	7	Basal Colorado	S	24.0	350
Amoco Canada*	David	Alta.	3/86	245	22	7	Lloydminster	S	29.0	1,480
CO_2 miscible										
Home Oil	Silverdale	Sask.	12/85	160	9	3	Sparky	S	29.0	2,000
Shell Canada	Harmattan East	Alta.	8/88	1,600	20	8	Mississippian Turner Val	Dolo.	14.0	10-300
Vikor	Joffre Viking	Alta.	12/82	320	4	4	Viking	S	13.0	500
Vikor	Joffre Viking	Alta.	8/85	480	6	3	Viking	S	13.0	500
Vikor	Joffre Viking	Alta.	6/88	560	5	1	Viking	S	13.0	500
Combustion										
Mobil Oil Canada	Battrum	Sask.	10/66	4,920	76	15	Battrum/Roseray	S	26.0	1,265
Mobil Oil Canada	Battrum	Sask.	8/67	2,400	35	7	Battrum/Roseray	S	25.0	930
Mobil Oil Canada	Battrum	Sask.	11/65	680	22	3	Roseray	S	27.0	930
Mobil Oil Canada	Fosterton Northwest	Sask.	1/70	200	1	0	Roseray	S	29.0	958
Pancanadian	Countess Upper Mannville B Pool	Alta.	1/83	40	4	1	Glauconite S.S.	S	25.0	800
Murphy	Evehill	Sask.	6/80	180	21	9	Cummings Waseca	S	34.0	6,000
Foam flood										
Signalta Resources	Pembina	Alta.	10/86	2,240	13	1	Ostracod	S	12.0	70
Hydrocarbon miscible										
Amoco Canada	Ante Creek Unit 1	Alta.	1968	6,080	15	10	Beaverhill Lake	LS	6.0	9
Amoco Canada	Bigoray Nisku B	Alta.	2/80	251	5	1	Nisku D-2	LS	5.0	1,130
Amoco Canada*	Kaybob South	Alta.	7/84	8,000	40	9	Triassic	Dolo.	11.5	92
Amoco Canada	Nipisi	Alta.	2/84	28,480	168	68	Gilwood	S	18.0	200
Amoco Canada	Rainbow S.	Alta.	8/72	490	5	2	Keg River	Dolo.	6.0	40
Amoco Canada	South Swan Hills	Alta.	1973	28,480	163	51	Beaverhill Lake	LS	8.0	49
Amoco Canada*	Willesden Green	Alta.	5/75	26,000	107	55	Cardium	S	11.0	5
Canadian Hunter Expl.	Brassey	B.C.	1/89	6,043	10	6	Artex	S	16.6	137
Chevron Canada Resources	Acheson D-3A	Alta.	7/87	610	15	1	Leduc D3	LS	12.0	5,000
Chevron Canada Resources	Bigoray Nisku F	Alta.	3/87	150	2	1	Nisku F	LS	10.0	250
Chevron Canada Resources	Kaybob North BHL Unit #1	Alta.	1/88	5,400	34	9	Beaverhill Lake	LS	7.5	50
Chevron Canada Resources	Mitsue, Stage 1 & 2	Alta.	5/85	17,280	140	55	Gilwood	S	13.4	282
Chevron Canada Resources	Pembina Nisku A	Alta.	2/84	400	3	1	Nisku A	LS	8.0	250
Chevron Canada Resources	Pembina Nisku D	Alta.	11/85	400	5	1	Nisku F	LS	12.0	750
Chevron Canada Resources	Pembina Nisku F	Alta.	6/86	200	3	1	Nisku F	LS	12.7	660
Chevron Canada Resources	W. Pembina Nisku A	Alta.	8/81	200	2	1	Nisku A	LS	10.0	750
Chevron Canada Resources	W. Pembina Nisku C	Alta.	4/84	130	2	1	Nisku C	LS	11.0	1,100
Chevron Canada Resources	W. Pembina Nisku D	Alta.	5/81	320	2	1	Nisku D	LS	10.0	300
Esso Resources Canada†	Pembina 'G' Pool	Alta.	9/89	328	4	1	Nisku	Dolo.	8.0	900
Esso Resources Canada†	Pembina 'K' Pool	Alta.	1984	126	2	1	Nisku	Dolo.	12.7	2,020
Esso Resources Canada†	Pembina 'L' Pool	Alta.	1985	625	5	2	Nisku	Dolo.	10.5	1,060
Esso Resources Canada†	Pembina 'M' Pool	Alta.	1983	192	2	1	Nisku	Dolo.	9.0	540
Esso Resources Canada†	Pembina 'O' Pool	Alta.	11/83	346	2	1	Nisku	Dolo.	11.8	3,100
Esso Resources Canada†	Pembina 'P' Pool	Alta.	10/83	420	4	1	Nisku	Dolo.	10.3	2,400
Esso Resources Canada†	Pembina 'Q' Pool	Alta.	2/85	301	2	1	Nisku	Dolo.	9.8	1,970
Esso Resources Canada†	Wizard Lake	Alta.	1969	2,725	49	14	Leduc D-3A	Dolo.	10.5	1,375
Esso Resources Canada Ltd.	Judy Creek	Alta.	5/85	29,050	186	65	Beaverhill Lake	LS	9.0	43
Esso Resources Canada Ltd.	Judy Creek	Alta.	1/87	8,290	52	22	Beaverhill Lake	LS	9.2	41
Esso Resources Canada Ltd.	Rainbow Keg River "FF" Pool	Alta.	5/72	102	2	1	344 ft	Dolo.	8.5	
Esso Resources Canada Ltd.	Rainbow Keg River "T" Pool	Alta.	5/69	222	3	1	394 ft	Dolo.	8.6	
Esso Resources Canada Ltd.	Rainbow Keg River "Z" Pool	Alta.	2/71	221	5	1	265 ft	Dolo.	4.25	
Esso Resources Canada Ltd.	Redwater	Alta.	1/85	1,000	25	4	Leduc D3	LS	5.0	10-5,000
Gulf Canada	Fenn-Big Valley	Alta.	4/83	1,268	26	7	Nisku	Dolo.	8.0	400
Gulf Canada	Goose River	Alta.	10/86	2,847	14	5	Beaverhill Lake	LS	8.0	240
Home Oil	Swan Hills	Alta.	10/85	19,440	196	39	Beaverhill Lake	LS	8.5	54
Husky Oil§	Rainbow B Pool	Alta.	6/84	2,500	28	9	Keg River	LS	8.0	300
Husky Oil§	Rainbow E Pool	Alta.	6/72	173	5	1	Keg River	LS	12.0	300
Husky Oil§	Rainbow EEE Pool	Alta.	4/70	150	2	1	Keg River	LS	16.8	500
Husky Oil§	Rainbow G Pool	Alta.	10/72	163	3	1	Keg River	LS	8.0	300
Husky Oil§	Rainbow H Pool	Alta.	6/73	165	3	1	Keg River	LS	9.4	200
Husky Oil§	Rainbow KRA Pool	Alta.	12/68	633	17	2	Keg River	LS	10.1	100
Husky Oil§	Rainbow KRD Pool	Alta.	3/75	85	1	1	Keg River	LS	10.0	200
Husky Oil§	Rainbow O Pool	Alta.	2/70	703	9	1	Keg River	LS	6.0	150
Mobil Oil Canada	Rainbow	Alta.	7/83	320	5	1	Keg River	Dolo./LS	8.5	100-1,000
Mobil Oil Canada	Rainbow	Alta.	9/72	800	14	2	Keg River	Dolo./LS	8.6	500
Petro-Canada	Brazeau River	Alta.	9/81	640	3	1	Nisku	LS	7.0	50
Petro-Canada	Brazeau River	Alta.	9/80	640	2	1	Nisku	LS	10.0	396
Petro-Canada	Brazeau River	Alta.	11/80	640	2	1	Nisku	LS	10.0	35
Petro-Canada	Caroline	Alta.	9/84	12,620	27	12	Cardium	S	10.0	12
Shell Canada	Simonette	Alta.	11/86	150	4	1	Leduc D-3	Dolo.	7.0	10-50
Shell Canada	Virginia Hills	Alta.	11/89	4,575	50	14	Beaverhill Lake	LS	9.0	1-500

Texas tax incentives

To spur EOR projects, the Texas legislature in 1989 reduced the oil severence tax to 2.7% from 4.6% for new tertiary recovery projects that started fluid injection after Sept. 1, 1989.

This reduced rate is to be in effect for a 10 year period as long as the project remains active. The rate applies to all oil from the project, not just the increase from enhanced recovery processes.

Not covered by this rate reduction are expansions of projects producing prior to Sept. 1, 1989, projects that change from one tertiary method to another, and pressure maintenance projects.

Table C

Depth, ft	Reservoir oil			Previous prod.	Satur. % start	Satur. % end	Project maturity	Total prod., b/d	Enh. prod., b/d	Project eval.	Profit	Project scope
	Gravity, °API	cp	°F.									
3,000	24.0	24.0	84	Prim./WF	62.0		NC	340	100	Prom.	Yes	P(Exp.L)
2,450	22.0	34.0	75	Prim./WF	60.0		HF			TETT		FW
1,837	16.0	5,000	60	Prim.	82.0	74.6	HF	130	130	Succ.	Yes	P(Exp. UL)
8,500	39.0	0.3	198	WF	40.0		JS	190	140	TETT		Exp. L
4,000	42.0	1.14	133	WF	40.0	28.0	HF			Succ.	No	P(Exp.L)
5,140	42.0	1.14	133	WF	38.0	27.0	HF			Prom.		P(Exp.L)
5,075	42.0	1.14	133	WF	36.0		JS			Prom.		P(Exp. L)
2,900	18.0	70.3	110	Prim.	66.0		HF	3,330	3,330	Succ.	Yes	FW
2,900	18.0	70.0	110	Prim.	62.0		HF	1,635	1,635	Succ.	Yes	FW
2,900	18.0	70.0	110	Prim.	70.0		HF	1,400	1,400	Succ.	Yes	FW
3,100	24.0	16.0	125	WF	62.0	40.0	NC	50	50	Prom.	No	P(Exp. UL)
3,550	28.0	6.0	100	WF	45.0	25.0	NC			Prom.		Exp. L
2,450	14.3	2,750	70	Prim.	100.0	80.0	HF	350	350	Prom.	Yes	P(Exp. UL)
5,659	42.0	0.35	135	G	78.0	31.0	NC	168	168	Prom.	Yes	FW
11,000	40.0	0.14	233	Prim.	90.0	60.0	NC	750	750	Succ.	Yes	FW
7,500	34.0	1.4	169	Prim.	70.0	30.0	HF	800	800	Succ.	Yes	FW
6,981	40.0	0.419	190	WF	46.0	31.0	NC	4,500	2,460	Prom.	Yes	FW
5,500	41.0	0.84	131	WF	30.0	5.0	HF	24,000	10,000	Succ.	Yes	FW
6,200	40.0	0.3	183	Prim.			NC	1,250	1,250	Succ.	Yes	FW
8,500	38.0	0.4	225	Prim./WF	35.0	13.0	NC	13,200	13,200	Succ.	Yes	FW
6,400	38.0	0.55	136	Prim.	87.0	73.0	NC	1,600	1,600	Disc.	No	FW
9,850	57.0	0.097	210		98.0	33.0	JS	3,800		Prom.		FW:(Exp.L)
5,000	39.0	0.85	139	Prim.	90.0	29.0	JS	2,400	1,400	Succ.	Yes	FW
10,500	37.0	0.8	175	WF	90.0	5.0	JS	4,000	1,100	Succ.	Yes	FW
9,780	42.0	0.19	234	WF	30.0	5.0	JS	5,600		TETT	No	FW
5,000	41.0	0.65	147	WF	30.0	19.0	JS	14,300	9,000	Succ.	Yes	FW
10,000	41.0	0.3	210	WF	80.0	5.0	JS	4,450	1,700	Succ.	Yes	FW
9,000	41.0	0.7	176	WF	90.0	5.0	HF	6,400	1,700	Succ.	Yes	FW
8,000	40.0	0.5	208	WF	75.0	43.3	JS	2,271	705	TETT		FW
10,000	42.0	0.3	228	Prim.	90.0	5.0	HF	4,466	2,766	Succ.	Yes	FW
10,300	42.0	0.3	218	WF	75.0	9.0	HF	6,000	2,500	Succ.	Yes	FW
10,000	42.0	0.2	218	Prim.	90.0	5.0	HF	3,800	2,300	Succ.	Yes	FW
9,541	43.2	0.33	204	Prim.	80.0	5.0	HF	3,500	2,100	Prom.	Yes	FW
9,469	43.6	0.37	198	Prim	82.0	5.0	HF	2,900	1,450	Prom.	Yes	FW
9,415	40.9	0.42	199	WF	88.0	5.0	HF	7,633	2,979	Prom.	Yes	FW
9,333	41.1	0.14	198	Prim.	93.0	5.0	HF	3,131	1,461	Prom.	Yes	FW
9,332	43.4	0.32	190	Prim.	84.0	5.0	JS	2,200	1,490	Prom.	Yes	FW
9,531	45.4	0.36	200	Prim.	87.0	5.0	JS	5,800	3,610	Prom.	Yes	FW
9,421	41.3	0.42	196	Prim.	91.0	5.0	HF	3,280	1,710	Prom.	Yes	FW
6,500	38.0	0.54	167	Prim.	93.0	5.0	NC	9,600	9,600	Succ.	Yes	FW
8,850	41.6	0.38	206	WF	84.0	42.0	HF	14,750	8,200	Succ.		FW
9,150	42.1	42.0	206	WF	83.0	43.0	JS	4,720	1,760	Succ.		FW
4,160	37.0	0.59	188	Prim.	90.0		NC			Succ.		RW
4,330	40.0	0.69	188	Prim.	88.0		NC			Succ.		RW
4,040	38.0	0.547	190	Prim.	73.5		HF			Succ.		RW
3,280	35.0	2.85	94	Prim.	75.0	20-25.0	HF	685	550	Prom.	No	P
5,249	32.8	1.34	136	Prim.	33.0		HF	590	590	Succ.	Yes	FW
9,200	41.0	0.4	234	WF			HF	2,831	1,573	Prom.		Exp. L.
8,300	41.0	0.4	225	WF	30.0	5.0	JS	20,300	7,100	Succ.	Yes	FW
6,000	39.0	0.83	180	WF	52.0	23.0	JS	4,635	4,635	Prom.	Yes	FW
5,932	39.0	0.439	175	Prim.	91.0	27.0	HF	1,900	1,900	Succ.	Yes	FW
6,085	37.0	0.542	180	Prim.	95.0	29.0	NC	70	70	Succ.	Yes	FW
6,151	39.0	0.485	185	Prim.	92.0	28.0	HF	1,528	1,528	Succ.	Yes	FW
6,210	39.0	0.596	187	Prim.	92.0	28.0	HF	572	572	Succ.	Yes	FW
6,380	43.0	0.29	195	Prim.	90.0	30.0	HF	2,610	2,610	Succ.	Yes	FW
6,310	40.0	0.426	195	Prim.	90.0	27.0	NC	141	141	Succ.	Yes	FW
6,053	42.0	0.28	180	Prim.	87.0	26.0	NC	650	650	Succ.	Yes	FW
5,500	39.0	0.46	190	WF	40.0	10.0	HF	600	600	Prom.	Yes	FW
5,500	39.0	0.47	184	GI/WF	80.0	10.0	HF	1,900	1,900	Succ.	Yes	FW
10,091	42.0	0.38	216	Prim.	90.0	15.0	HF	3,100	3,100	Succ.	Yes	FW
10,215	44.0	0.4	218	Prim.	90.0	10.0	HF	7,400	7,400	Succ.	Yes	FW
10,544	46.0	0.2	222	Prim.	90.0	15.0	HF	2,500	2,500	Succ.	Yes	FW
8,200	46.0	0.25	173	Prim.	85.0	45.0	HF	1,900	1,550	Succ.	Yes	FW
11,600	47.0	0.13		WF			NC	160	135	Disc.		Exp. UL
9,500	34.0	0.53	221	WF	56.0	36.0	JS	11,000		TETT		Exp. L

Producing Canadian EOR projects—continued

Operator	Field	Province	Start date	Area, acres	– Number wells –		Pay zone	Formation type	Porosity, %	Permeability, md
					Prod.	Inj.				
Hot Water										
Alberta Energy	S. Jenner Up. Mannville J. Pool	Alta.	9/89	2	3	1	Glauconitic	S	25.0	1,560
Polymer										
BP Exploration	Chauvin South	Alta.	2/88	300	10	3	Sparky E	S	15-27	1,076
Chevron Canada Resources	Taber Mannville D Unit #1	Alta.	6/87	480	7	2	Mannville D	S	22.3	1,140
Encor Energy	Rapdan Unit	Sask.	1/86	440	12	5	Upper Shaunavon	S	17.0	85
Steam										
Amoco Canada	Elk Point	Alta.	4/89	33	9	4	Lower Cummings	S	30.0	1,500
Amoco Canada	Lindbergh	Alta.	11/85	120	12	12	Lower Cummings	US	32.0	4,000
Esso Resources Canada†	Lone Rock	Sask.	11/84	45	13	3	Sparky	S	34.4	2,800
Home Oil	Kitscoty	Alta.	6/81	160	12	15	Sparky B	S	27.6	905
Mobil Oil Canada	Celtic (Multi-zone)	Sask.	9/88	160	16		General Petro & Waseca	S	35.0	1-2,000
Norcen	Provost	Alta.	3/85	20	8	1	McLaren	S	27-30.0	4,000
Sceptre Resources	Tangleflags North	Sask.	12/87	17	1	3	Lloydminster Sand	US	32.5	5,000

*Former operator: * Dome, † Texaco, §Canterra Energy.

Completed, terminated Canadian projects

Operator	Field	Province	Start date	Area, acres	– Number wells –		Pay zone	Formation type	Porosity, %	Permeability, md
					Prod.	Inj.				
Caustic-polymer										
Pancanadian	Horsefly Lake	Alta.	12/84	34	5	4	Lower Mannville	S	18.0	260
CO_2 miscible										
Shell Canada	Midale	Sask.	10/85	5	3	4	Midale	LS/Dolo.	16.0	3
Combustion										
Husky	Tangleflags	Sask.	1985	240	19	3	GP	US	33.0	4,000
Mobil Oil Canada	Kitscoty	Alta.	9/75	1,040	84	7	Sparky	S	34.0	2,000
Electromagnetic										
Canada Northwest Energy	Wildmere	Alta.	1/86	120	3		Lloydminster	S	30.0	800
Steam										
Canada Northwest Energy	Atlee Buffalo	Alta.	9/86	640	10		Glauconite	S	30.0	2,000
Husky	Frog Lake	Alta.	1985	20	4	1	Colony	US	33.0	2,500
Husky	Charlotte Lake	Alta.	1985	20	2	2	Rex	US	33.0	3,000
Mobil Oil Canada	Celtic	Sask.	4/85	50	5		General Petro.	S	35.0	2,000
Mobil Oil Canada	Celtic	Sask.	10/80	125	25		Waseca	S	35.0	1,000
Steam soak										
Phillips Petroleum	Coleville	Sask.	11/84	35	2	2	Bakken	S	25.0	400

Producing EOR projects outside U.S. and Canada

Country	State/area	Operator	Project type	Field	Start date	Area, acres	No. wells Prod.	No. wells Inj.	Pay zone	Formation	Porosity, %	Permeability, md
Colombia	Mid. Magdalena basin	Texas Petroleum	Steam	Cocorna	3/87	15	8	3	Oligocene B	S	28	700
Colombia	Mid. Magdalena basin	Texas Petroleum	Steam	Teca	2/84	3,000	200		Oligocene A & B	S	28	1,200
France	Paris	Elf Aquitaine	Polymer	Chateaurenard (Courtenay)	1/89	250	12	4	Neocomian	S	30	2,000
France		Elf Aquitaine	Steam	Lacq Superieur	1977	30	8	1	Senonien	LS	15	1
France	Paris	Elf Aquitaine	Steam	Lacq Superieur	1/89	30	8	1	Senonien	LS	15	10
Hungary		NKFV	CO_2	Nacylengyel	10/88	2,890	104	11	I-IV Rudistic	LS	1.06	1,000
Hungary		NKFV	CO_2	Nagylengyel	9/80	200	5	1	Triassic	Dolo.	2.5	1,000
Hungary		NKFV	CO_2	Budafa	1981	1,013	77	60	Zala Kerettye	S	22	110
Hungary		NKFV	Combustion	Demjen East	1986	14	8	3	Oligocene c,da,df,e	S	19	100
Indonesia		Total	Micellar polymer	Handil	1982	4	1	3		S	30	1,000
Indonesia	Pekanbaru	PT Caltex	Steam	Duri	4/85	4,000	952	288	Pertama - Kedua	US	32-36	1,550
Libya		Zueitina Oil	HC miscible	Intisar 103D	1/69	3,325	20	6	"D" Reef	LS	23.9	226
Trinidad	Forest Reserve	Trintoc	CO_2 immiscible	Forest Reserve (Area 2102)	6/76	58	6	3	Forest sands	S	30	175
Trinidad	Forest Reserve	Trintoc	CO_2 immiscible	Forest Reserve (Area 2121)	1/74	29	4	3	Forest sands	S	30	150

Table C

Depth, ft	Reservoir oil Gravity, °API	cp	°F.	Previous prod.	Satur. % start	Satur. % end	Project maturity	Total prod., b/d	Enh. prod., b/d	Project eval.	Profit	Project scope
2,950	14.0	170.0	90	Prim.	75.0		JS	95		TETT		P
2,100	21.5	43.1	78	WF	60.0		JS	440		Prom.		P
3,200	18.0	55.0	121	WF	92.0	7.0	JS	17,600	16,400	TETT	Yes	FW
4,500	23.0	10.0	132	WF	55.0	43.0	HF	880	660	Succ.	Yes	P (Exp. L)
2,000	12.0	25,000	73	Prim./C	80.0		JS			TETT		P
1,950	12.0	15,000	75	Prim.	72.0		HF			Prom.	Yes	P(Exp L)
1,900	16.0	800	70	Prim.	82.0		NC	200	200	Prom.	No	P(Exp. UL)
2,066	13.0	8,000	60	Prim.	80.0	52.0	NC	400	325	Succ.	Yes	P(Exp. UL)
1,600	13.0	2-5,000	60	Prim.	70.0		JS	800		TETT		P
2,430	12.0	2,000	80	Prim.	82.0	45.0	JS	420	420	Prom.	No	P(Exp.L)
1,476	12-13.0	13,000	66	Prim.	80.0	15.0	HF	600	550	Prom.	Yes	P

Table D

Depth, ft	Reservoir oil Gravity, °API	cp	°F.	Previous prod.	Satur. % start	Satur. % end	Project maturity	Total prod., b/d	Enh. prod., b/d	Project eval.	Profit	Project scope
3,200	23.0	13	94	WF	51	40	Term.					Exp. UL
4,600	28.0	3	150	Prim./WF	35		C					P
1,700	14.5	4,000	74	Prim.	77		Term.	550	550	Succ.	Yes	UL
1,800	12.2	15,000	70	Prim.	85	60-68	Term.	610	305	Disc.	No	P
2,100	12	8,000	75	Prim.	85		Term.	80	60	Prom.	Yes	P (Exp. L)
2,900	14.5	800	80	Prim.	80	1	Term.	0	0	Succ.	Yes	Exp. L
1,400	12	100,000	60		80	65	Term.	45	45	Disc.	No	UL
1,400	10.8	107,000	70		80		Term.			Disc.	No	UL
1,576	13	7,000	67	Prim.	69	46	Term.	290	190	Prom.		P (Exp. L)
1,500	13	5,380	61	Prim.	70	47	Term.	630	630	Prom.		P (Exp. L)
2,600	14	1,000	84	WF			C	60	22	Disc.	No	P

Table E

Depth, ft	Reservoir oil Gravity, °API	cp	°F.	Previous prod.	Satur. % start	Satur. % end	Project matur.	Total prod., b/d	Enh. prod., b/d	Project eval.	Profit	Project scope
2,100	12.8	2,965			57	19	HF	390	190	Prom.		P (Exp. L)
2,100	12.8	2,965		Prim.			HF	17,000	8,500	Succ.	Yes	FW
1,950	27	40	86	Prim.	45		JS	337	161	TETT	Yes	
1,950-2,100	22	20	150	Prim.	45		NC	1,000	400	Succ.	Yes	FW
1,950-2,100	22	20	150	Prim.	45		JS			Prom.		P
6,700	18	22	237	Prim.			JS	3,200	3,200	Prom.		
7,400	16	92	248	Prim.			NC	130	130	Succ.		
3,000	42	0.8	147	Prim.			NC	500	500	Succ.		
820	39	7	78	Prim.	55		HF	60	52	Prom.		Exp.L
4,500	33	0.4	115	WF	35			400	400			
625	22.7	157		Prim.	62	25	JS	145,000	115,000	Succ.	Yes	Exp. L
8,849	39.2	0.46	226		80	18	NC	40,000	40,000	Succ.	Yes	FW
3,000	29	3	120	Prim.	56		JS	25	25	Prom.		RW
2,600	17	66	120	Prim.	60		JS	10	10	Prom.		RW

Producing EOR projects outside U.S. and Canada—continued

Country	State/area	Operator	Project type	Field	Start date	Area, acres	No. wells Prod.	No. wells Inj.	Pay zone	Form-ation	Poro-sity, %	Permea-bility, md
Trinidad	Forest Reserve	Trintoc	CO_2 immiscible	Forest Reserve (Area 2124)	1/86	184	2	1	Forest sands	S	31.5	283-370
Trinidad		Trintoc	CO_2 cyclic	Forest Reserve	5/84		6		Forest sands	S	30	150-300
Trinidad	Point Fortin	Trintoc	Steam	P/F Cruse "E" Steam Proj.	2/86	66	28	3	Cruse E	S	31	95
Trinidad	Point Fortin	Trintoc	Steam	Parrylands	7/81	90	46	6	Forest sands	S	30	500
Trinidad	Forest Reserve	Trintoc	Steam	F/R Project III	7/65	135	53	14	Forest zone 5.1	S	33	340
Trinidad	Forest Reserve	Trintoc	Steam	F/R Phase I Reactivation	8/76	58	10	0	Forest sands	S	31	205
Trinidad	Forest Reserve	Trintoc	Steam	F/R Phase I West Expansion	12/88	50	29		Forest sands	S	30	430
Turkey	Ankara	TPAO	CO_2 immiscible	Bati Raman	3/86	10,709	96	23	Garzan	LS	18	58
Venezuela	Anzoategui	Corpoven S.A.	Gas	Oveja	8/61	5,467	31	4	I2L,3(YAC.OG-503)	S	37	2,500
Venezuela	Anzoategui	Corpoven S.A.	Gas	Oveja	1/67	1,325	4	1	L1L(YAC.OM-101)	S	31	2,940
Venezuela	Anzoategui	Corpoven S.A.	Gas	Oveja	1/64	2,422	14	2	J-3(OM-100)	S	28	10,000
Venezuela	Monagas	Corpoven S.A.	Gas	Oritupano	9/76	1,054	7	1	A-7(YAC.ORM-33)	S	30	1,000
Venezuela	Anzoategui	Corpoven S.A.	Gas	Oveja	5/64	1,686	9	2	L1L(YAC.OM-104)	S	30.4	2,642
Venezuela	Campo Cerro Negro	Lagoven S.A.	Steam	B.E.P.-Cerro Negro	1984	49,090	144		Ofic. Morichal-Memb.	S	32	7,000
Venezuela	Campo Jobo	Lagoven S.A.	Steam	Jobo	12/69	4,329	18		Ofic. Jobo Member	S	32	2,500
Venezuela	Campo Jobo	Lagoven S.A.	Steam	Jobo - P.E.T.C.	8/85	267	17		Oficina	S	30	8,000
Venezuela	Campo Jobo	Lagoven S.A.	Steam	Jobo	12/69	27,522	99		Ofic. Mor-Member	S	31	5,000
Venezuela	Campo Pilon	Lagoven S.A.	Steam	West Pilon	12/69	1,065	29		Oficina-1	S	29.1	5,000
Venezuela	Zulia	Lagoven S.A.	Steam	Bachaquero	12/80	343	2		Bachaquero Superior	S	23	1,500
Venezuela	Zulia	Lagoven S.A.	Steam	Lagunillas	2/71	9,343	308	2	Bachaquero	S	34	4,000
Venezuela	Zulia	Lagoven S.A.	Steam	Tia Juana	2/70	1,692	25		Lagunillas Inferior	S	31	1,250
Venezuela	Zulia	Maraven S.A.	Steam	East Tia Juana	3/69	1,773	145		L.L.	S	38.1	780
Venezuela	Zulia	Maraven S.A.	Steam	Lagunillas	4/65	420	59		U.L.H.	S	35	
Venezuela	Zulia	Maraven S.A.	Steam	East Tia Juana	4/59	339	33		L.L.	S	38.1	
Venezuela	Zulia	Maraven S.A.	Steam	East Tia Juana	8/69	415	24		L.L.	S	38.1	
Venezuela	Zulia	Maraven S.A.	Steam	Lagunillas	11/79	3,101	267		L.L.	S	33.7	
Venezuela	Zulia	Maraven S.A.	Steam	East Tia Juana	9/64	415	36		L.L.	S	38.1	3,000
Venezuela	Zulia	Maraven S.A.	Steam	Main Tia Juana	10/63	873	82		L.L.	S	38.1	1,400
Venezuela	Zulia	Maraven S.A.	Steam	East Tia Juana	8/68	2,629	224		L.L.	S	38.1	3,000
Venezuela	Zulia	Maraven S.A.	Steam	East Tia Juana	8/69	1,642	131		L.L.	S	38.1	1,300
Venezuela	Zulia	Maraven S.A.	Steam	Lagunillas	4/70	2,565	220		U.L.H.	S	35	
Venezuela	Zulia	Maraven S.A.	Steam	Main Tia Juana	7/67	1,271	114		L.L.	S	38.1	675
Venezuela	Zulia	Maraven S.A.	Steam	Main Tia Juana	7/67	1,500	134		L.L.	S	38.1	750
Venezuela	Zulia	Maraven S.A.	Steam	Main Tia Juana	6/68	141	15	7	L.L.	S	33	675
Venezuela	Zulia	Maraven S.A.	Steam	Main Tia Juana	10/67	2,221	197		L.L.	S	38.1	750
Venezuela	Zulia	Maraven S.A.	Steam	Lagunillas	1/70	3,025	147		L.L.	S	33.7	
Venezuela	Zulia	Maraven S.A.	Steam	East Tia Juana	1/74	1,830	135	21	L.L.	S	38.1	780
Venezuela	Zulia	Maraven S.A.	Steam	Bachaquero	10/84	7,795	539		Post-Eoceno	S	37.3	600
Venezuela	Zulia	Maraven S.A.	Steam	East Tia Juana	2/61	36	7		L.L.	S	38	1,300
Venezuela	Zulia	Maraven S.A.	Steam	Lagunillas	7/67	618	54		U.L.H.	S	35	
Venezuela	Zulia	Maraven S.A.	Steam	Main Tia Juana	6/66	141	15		L.L.	S	38.1	675
Venezuela	Zulia	Maraven S.A.	Steam	Lagunillas	11/80	3,565	299		U.L.H.	S	35	
Venezuela	Zulia	Maraven S.A.	Steam	Lagunillas	8/70	2,114	175		U.L.H.	S	35	
Venezuela	Zulia	Maraven S.A.	Steam	East Tia Juana	5/68	2,667	232		L.L.	S	38.1	
Venezuela	Zulia	Maraven S.A.	Steam	East Tia Juana	12/68	1,956	168		L.L.	S	38.1	
Venezuela	Zulia	Maraven S.A.	Steam	Lagunillas	1/70	76	7		L.L.	S	33.7	
Venezuela	Anzoategui	Corpoven S.A.	Steam	Bare (F.O.)	3/85	16,452	47	48	U1,3(YAC.MFB-53)	US	31.9	6,600
Venezuela	Anzoategui	Corpoven S.A.	Steam	Arecuna (F.O.)	2/85	1,668	45	5	5	US	30.7	5,800
Venezuela	Anzoategui	Corpoven S.A.	Steam	Bare (F.O.)	3/87	8,066	61	65	U2,3(YAC,MFB-23)	US	28.6	5,000
Venezuela	Anzoategui	Corpoven S.A.	Steam	Arecuna (F.O.)	12/83	1,544	15	15	T(YAC.MFA-52)	US	30.6	4,500
West Germany	Lower Saxony	Wintershall AG	Hot Water	Emlichheim 14	10/67	64	5	1	Valenginian	S	30	6,000
West Germany	Lower Saxony	Wintershall AG	Hot Water	Emlichheim 17	10/74	82	9	2	Valenginian	S	30	6,000
West Germany	Lower Saxony	Wintershall AG	Hot Water	Emlichheim 11	9/73	70	8	1	Valenginian	S	30	6,000
West Germany	Lower Saxony	Wintershall AG	Hot Water	Emlichheim 07	10/67	82	5	1	Valenginian	S	30	6,000
West Germany	Northwest	Preussag AG	Polymer	Edesse-Nord	11/85	4	3	2	Wealden	S	24	1,200
West Germany	Northwest	Preussag AG	Polymer	Vorhop-Knesebeck	11/89	345	3	1	Dogger-Beta	S	28	1,000
West Germany		RWE-DEA*	Polymer	Hankensbuettel Westblock 4	4/77	70	7	2	Upper Dogger-Beta	S	28	2,000-4,000
West Germany		RWE-DEA*	Polymer	Hankensbuettel Westblock 2	5/79	75	6	3	Upper Dogger-Beta	S	28	2,000-4,000
West Germany		RWE-DEA*	Polymer	Westblock	1980	410	13	3	Upper Dogger-Beta	S	28	2,000-4,000
West Germany		RWE-DEA*	Polymer	Hankensbuettel, South Block	1/84	15	2	1	Dogger-Beta	S	26	1,000-2,000
West Germany		RWE-DEA*	Polymer	Ploen OST	1/89	30	3	1	Dogger-Beta	S	19	200-1,500
West Germany		RWE-DEA*	Polymer	Hohne	1/84	73	4	3	Dogger-Beta	S	26	2,000
West Germany	Lower Saxony	Wintershall AG	Polymer	Bockstedt	9/84	57	4	1	Valenginian	S	23	4,000
West Germany	Emsland	BEB	Steam	Ruhlermoor II	8/86	360	40	4	Valanginian	S	27-31.0	600-1,000
West Germany	Lower Saxony	BEB	Steam	Georgsdorf I	1/75	165	19	2	Valanginian	S	25	460-1,150
West Germany	Lower Saxony	BEB	Steam	Georgsdorf II	12/79	144	23	3	Valenginian	S	25	1,000-1,300
West Germany	Lower Saxony	BEB	Steam	Ruhlermoor I	11/80	220	30	4	Valenginian	S	28-30.0	300-1,000
West Germany	Emsland	BEB	Steam	Ruhlermoor III	12/87	400	40	6	Valenginian	S	25-28	300-800
West Germany	Lower Saxony	Wintershall AG	Steam	Ruehlertwist	12/78	237	26	3	Valenginian	S	28	5,000
West Germany	Lower Saxony	Wintershall AG	Steam	Emlichheim 06	5/81	121	15	4	Valenginian	S	30	6,000

Former operator: *Texaco AG

Completed, terminated projects outside U.S. and Canada

Country	State/area	Operator	Type projects	Field	Start date	Area, acres	No. wells Prod.	No. wells Inj.	Pay zone	Form-ation	Poro-sity, %	Permea-bility, md
Austria		OMV	Caustic	Matzen/Scho	7/80	33	5	1	Torton 9th	S	23.5	300
Austria		OMV	Caustic	Matzen/Scho	7/80	33	5	1	Torton 9th	S	23.5	300
Austria		OMV	Steam	Maustrenk	7/80	123	19	3	Schlier		24	147
Congo		Elf Congo	Steam	Emeraude-Offshore	1/82	9	8	2	Senonien	S	25	80
England		BP	Micellar-polymer	Bothamsall	7/83	10	3	1	Sub-Alton	S	12	14
France		Elf Aquitaine	Micellar-polymer	Chateaurenard	1/84	71	9	4	Necomian	S	30	1,300
France		Elf Aquitaine	Polymer	Chateaurenard	1/85	12	4	1	Necomian	S	30	1,000
Venezuela	Monagas	Corpoven S.A.	Gas	Oritupano	2/79	1,100	6	1	A-9(YAC.ORM-27)	S	28	1,300
Venezuela	Campo Jobo	Lagoven S.A.	Steam	Jobo Picv	3/81	90	22	6	Morichal-1	S	32	10,000
Venezuela	Zulia	Lagoven S.A.	Steam	Lagunillas	10/66		2		Lagunillas Inferior	S	38	2,150
Venezuela	Zulia	Lagoven S.A.	Steam	Bachaquero	6/70	55			Bachaquero	S	30	1,761

Table E

Depth, ft	Reservoir oil			Previous prod.	Satur. % start	Satur. % end	Project matur.	Total prod., b/d	Enh. prod., b/d	Project eval.	Profit	Project scope
	Gravity, °API	cp	°F.									
3,850	25	5.7	120	WF	44		JS	60	50	TETT		RW
2,500	20-25.0	66-90	120	Prim.	60		JS	10	10	Prom.		P (Exp. L)
1,200-1,600	16-18.0	150-200	110-115	Prim.	58	18	JS	270	270	Prom.		FW
1,000-1,200	11.5	5,000	110	Prim.	75	20	JS	640	640	Prom.		FW
1,000-1,300	15.7	148	110	Prim.	70	20	HF	1,300	1,300	Succ.	Yes	FW
1,200	19	32	105	Prim.	57	15	JS	125	125	Prom.		RW
1,500	12.3-17.8	160	105	Prim.	67	25	JS	75	75	TETT		P (Exp. L)
4,265	13	592	129		78		HF	7,400	6,800	Succ.		FW
3,150	15	38	150	Prim.	90	67	HF	5,000	5,000	Prom.	Yes	FW
3,430	21	5.5	154	WF	90	63	NC	1,300	1,300	Succ.	Yes	FW
3,300	20	52	149	WF	90	50	HF	2,250	2,250	Succ.	Yes	FW
5,150	20.5	4.9	146	Prim.	90	72	HF	550	550	Succ.	Yes	FW
3,350	18	12.5	152	WF	90	65	NC	2,600	2,600	Succ.	Yes	FW
2,800	8.5	5,500		Prim.	80		HF	10,000	8,000	Succ.	Yes	P (Exp. L)
	12.6	80		Prim.	80		JS	2,500	180	Succ.	Yes	FW
4,025	8.5	1,850		Prim.	75		HF	2,500	2,000	Succ.	Yes	P (Exp. L)
3,600	8.5	1,850		Prim.	85		JS	27,100	1,430	Succ.	Yes	FW
3,200	9.5	1,850		Prim.	82.2		JS	4,350	450	Succ.	Yes	FW
3,400	14	185	135	Prim.	85		JS	9		TETT	No	P (Exp. L)
2,690	12	600	128	Prim.	84		HF	13,511	7,216	Succ.	Yes	FW
2,537	15	93	119		72		HF	1,870	870	Prom.	Yes	
1,700	11.9	2,000	111	Prim.	92.7	74.5	HF	4,320	3,400	Prom.	Yes	
2,100	11.4	3,500	117	Prim.	96.9	58.7	NC	2,510	1,150	Succ.	Yes	FW
1,500	12.2	1,000	108	Prim.	92.6	72.3	HF	490	150	Prom.	Yes	FW
850	10.5	10,000	95	Prim.	99.9	84.6	HF	810	810	Prom.	Yes	FW
2,615	15	580	126	Prim.	83.3	68.8	HF	3,526	1,690	Prom.	Yes	FW
1,250	12	3,000	104	Prim.	95.6	78.6	HF	500	330	Prom.	Yes	FW
1,750	13.1	750	113		86	74	NC	2,036	1,297	Prom.	Yes	FW
1,000	11.6	4,000	104	Prim.	94.6	79.6	HF	3,217	2,550	Prom.	Yes	FW
1,250	10.2	12,000	102	Prim.	99.9	89.9	HF	2,325	2,325	Prom.	Yes	FW
1,750	11.8	2,500-11,500	115	Prim.	97.3	89.4	HF	12,150	6,500	Prom.	Yes	FW
1,220	13.1	6,000	123	Prim.	94.3	80.8	HF	2,188	1,375	Prom.	Yes	FW
1,400	11.8	1,000	110	Prim.	91.1	76	HF	3,195	1,950	Prom.	Yes	FW
1,250	13.1	1,000	113	Prim.	88	68		3,100	2,000	Prom.	Yes	P
1,746	13.1	4,100	110	Prim.	95.1	80.9	HF	5,924	4,700	Prom.	Yes	FW
2,500	15.2	500-4,500	122	Prim.	86	74.3	HF	2,840	1,130	Prom.	Yes	FW
1,590	12	1,000	111		81	56	HF	7,500	6,800	Succ.	Yes	FW
2,000	13	300-800	117	Prim.	85	73	JS	8,800	4,000	Prom.	Yes	FW
1,000	9.5	12,000	105	Prim.	100	76.9	NC	140	140	Prom.	Yes	P
2,100	11.4	3,500	117	Prim.	9	7	NC	3,080	1,400	Succ.	Yes	FW
1,250	13.1	1,300	104	Prim.	92	78	NC	120	25	Prom.	Yes	FW
2,398	11	2,000-3,700	125	Prim.	90.6	77.9	HF	16,260	5,510	Prom.	Yes	FW
1,725	11.4	4,000-9,000	118	Prim.	97.8		HF	7,380	3,620	Prom.	Yes	FW
1,200	12	500	104		93.6	82.5	HF	4,510	3,600	Prom.	Yes	FW
1,250	11.7	7,500	106	Prim.	97.5	82.5	HF	4,174	3,450	Prom.	Yes	FW
2,600	15.2	250	125	Prim.	73.7	63.5	NC	270	220	Succ.	Yes	P
2,650	9.3	376	131	Prim.	88	75	HF	26,675	17,340	Succ.	Yes	RW (Exp. L)
2,850	10	370	135	Prim.	82	74	NC	505	50	Disc.	No	P (Exp. UL)
3,050	9.2	351	136	Prim.	83	75	HF	177,000	8,280	Succ.	Yes	RW (Exp. L)
3,150	9.8	560	140	Prim.	80	72	NC	2,875	1,150	Prom.	Yes	RW
2,550	24.5	175	95	WF	73	58	NC	230	230	Succ.	Yes	FW
2,300	24.5	175	95	WF	66	55	HF	210	200	Succ.	Yes	FW
2,550	24.5	175	95	WF	72	68	NC	85	80	Succ.	Yes	FW
2,400	24.5	175	95	WF	70	56	NC	210	210	Succ.	Yes	FW
1,200	36	8	73	WF	53	37	NC	13	5	Succ.	No	P (Exp. L)
3,600	33	4	133	WF	65.5	55.2	JS	300	180	TETT		RW
4,900	27	13	136	WF	69	29	NC	120	90	Succ.	Yes	Exp. L
4,900	26	13	136	WF	72	33	NC	320	250	Succ.	Yes	Exp. L
4,900	25	17	136	WF	60	50	NC	200	160	Succ.	Yes	Exp. L
4,800	32	6	136	WF	65	47	HF	130	90	Succ.	Yes	Exp. L
9,400	35	1.3	195	WF	34		JS	150	0	TETT		P
3,800	32.6	5.3	133	WF	67		HF	150	50	TETT		
4,100	34	11	130	WF	39	33	HF	125	50	Prom.		P
1,700-2,100	25	120		Prim.	78		HF	2,880	2,220	Succ.	Yes	FW
2,130-2,790	27	120	95	Prim.			HF	1,120	975	Succ.	Yes	
2,130-2,790	27	120	95	Prim.			HF	1,340	1,020	Succ.	Yes	
2,070-2,460	25	120	96	Prim.			HF	1,780	1,520	Succ.	Yes	
1,700-2,100	25	120	96	WF			JS	3,100	2,160	Succ.	Yes	FW
2,650	25	175	100		51	42	HF	1,000	935	Succ.	Yes	P (Exp. L)
2,400	24.5	175	95	HW	62	45	NC	1,210	1,205	Succ.	Yes	P (Exp. L)

Table F

Depth, ft	Reservoir oil			Prev. prod.	Satur. % start	Satur. % end	Proj. maturity	Total prod., b/d	Enh. prod., b/d	Proj. eval.	Profit	Proj. scope
	Gravity, °API	cp	°F.									
4,330	21	12.7	120	Prim./WF	62	43	Term.	78	21	Succ.	Yes	P (Exp. L)
4,330	21	12.7	120	Prim.WF	53	35	Term.	52	4	Disc.	No	P (Exp. UL)
3,018	26	7.81	98	Prim./WF	51	46	Term.	84	54	Disc.	No.	
600	22	100	85	Prim.			Term	1,600	1,600	Succ.		P
3,140	41	3	110	WF	57	50	C	15	5	Disc.	No	P
1,950	27	40	86	Prim.	48	23	C	118	32	Succ.	No	P (Exp. UL)
1,950	27	40	86	Prim.	55	30	C	144	108	Succ.	Yes	P (Exp. L)
5,200	21	4.9	146	Prim.	84	69	Term.	800	800	Disc.	No	Exp. UL
3,600	8.5	1,800		Prim.	82		C			Succ.	Yes	P (Exp. UL)
	16		135	Prim.	90		Term.	30	20	Disc.	Exp. UL	
4,325		57	137		84		Term.	5,178	2,848	Prom.	Yes	

Completed, terminated projects outside U.S. and Canada—continued

Country	State/area	Operator	Type projects	Field	Start date	Area, acres	No. wells Prod.	No. wells Inj.	Pay zone	Form-ation	Poro-sity, %	Permea-bility, md
Venezuela	Zulia	Lagoven S.A.	Steam	Cabinas	8/71	96	3		Lagunillas Inferior		31	900
Venezuela	Zulia	Lagoven S.A.	Steam	Tia Juana	7/65	2,066	17		Lagunillas Inferior	S	36	1,064
Venezuela	Anzoategui	Corpoven S.A.	Steam soak	BARE (F.O.)	9/84	1,547	7	7	U-1 (YAC.OS-721)	US	27.9	2,000
Venezuela	Anzoategui	Corpoven S.A.	Steam soak	Melones Central	4/83	35,809	25	26	U1,2,2(YAC.MEL-15)	US	34	1,500
West Germany	Lower Saxony	Wintershall AG	Hot water	Emlichheim 15	1/67	115	6	2	Valenginian	S	30	6,000
West Germany		Wintershall AG	Hot water	Ruehlertwist	12/86	53	8	2	Valenginian	S	30	400
West Germany	Lower Saxony	Wintershall AG	Hot water	Emlichheim 10	11/81	41.5	3	1	Valenginian	S	30	1,200
West Germany	Northwest	Preussag AG	Polymer	Edesse-Nord	11/85	4.2	3	2	Wealden	S	24	6,000
West Germany		RWE-DEA	Surfactant	Hankensbuettel Westblock	1/81	83	7	3	Lower Dogger-Beta	S	28	300-1,000

Producing thermal EOR in U.S.

Operator	Field	State	County	Start date	Area, acres	–Number wells– Prod.	Inj.	Pay zone	Form-ation type	Poro-sity. %
Steam										
Amoco	Winkleman Dome	Wyo.	Fremont	1964	160	19	13	Nugget	S	22.8
ARCO*	Kern River	Calif.	Kern	1970	80	112	33	Kern River series	S	31.0
ARCO*	Kern River	Calif.	Kern	1970	95	71	29	Kern River series	S	33.0
ARCO*	Kern River	Calif.	Kern	9/72	38	32	16	Kern River series	S	31.0
ARCO*	Kern River	Calif.	Kern	1972	50	41	20	Kern River series	S	31.0
ARCO	Midway-Sunset	Calif.	Kern	1/72	8	31	4	Potter	S	32.0
ARCO*	Midway-Sunset	Calif.	Kern	4/84	25	24	2	Potter	S	34.0
ARCO*	Midway-Sunset	Calif.	Kern	1983	34	13	2	L. Monarch	S	30.0
ARCO*	Midway-Sunset	Calif.	Kern	3/73	29	24	2	Potter	S	34.0
ARCO*	Midway-Sunset	Calif.	Kern	1985	22	17	5	U. Monarch	S	29.0
ARCO*	Midway-Sunset	Calif.	Kern	4/85	30	26	5	Potter	S	34.0
ARCO*	Midway-Sunset	Calif.	Kern	1973	40	70	10	Monarch	S	32.0
ARCO	Midway-Sunset	Calif.	Kern	6/89	24	42	6	Potter	S	34.0
ARCO	Midway-Sunset	Calif.	Kern	8/72	9	35	4	Monarch	S	32.0
ARCO*	Midway-Sunset	Calif.	Kern	1984	15	12	0	Sub Lakeview	S	30.0
ARCO*	Midway-Sunset	Calif.	Kern	1969	50	60	15	Metson	S	30.0
ARCO	Midway-Sunset	Calif.	Kern	2/72	200	50	3	Potter	S	32.0
ARCO	Midway-Sunset	Calif.	Kern	12/84	160	12	0	MYA TAR	S	32.0
ARCO*	Placerita	Calif.	Los Angeles	1986	95	70	17	L. Kraft	S	28.0
Bechtel	Elk Hills	Calif.	Kern	7/87	20	9	4	Sub-Scalez, Shallow oil zone	US	30.0
Chevron	Cymric 26W	Calif.	Kern	10/89	30	31	19	Tulare	S	33.0
Chevron	Cymric 36W	Calif.	Kern	5/75	110	98	47	Tulare/Amnicola	S	33.0
Chevron	Cymric 6Z	Calif.	Kern	2/86	30	31	19	Tulare	S	33.0
Chevron	Cymric Sec. 31X	Calif.	Kern	4/79	69	38	17	Amnicola	S	35.0
Chevron	Edison 27-RT	Calif.	Kern	7/77	30	65	29	Kern River	S	30.0
Chevron	Kern River KCL 39	Calif.	Kern	10/75	118	67	42	Kern River	S	33.0
Chevron	Kern River MCCII	Calif.	Kern	4/71	80	129	30	Kern River	S	34.0
Chevron	Kern River Sec. 3	Calif.	Kern	9/68	424	345	155	Kern River	S	34.0
Chevron	Kern River Sec. 4	Calif.	Kern	6/78	156	200	64	Kern River	S	34.0
Chevron	Kern River MC1	Calif.	Kern	4/76	132	120	76	Kern River	S	34.0
Chevron	Kern River—ANO	Calif.	Kern	5/74	160	177	82	Kern River	S	32.0
Chevron	Lost Hills Sec. 18	Calif.	Kern	7/83	38	39	11	Tulare	S	38.0
Chevron	Lost Hills Sec. 18	Calif.	Kern	8/85	14	8	0	Tulare	S	38.0
Chevron	Lost Hills Sec. 30	Calif.	Kern	1/80	190	37	0	Etchegoin A	S	40.0
Chevron	McKittrick	Calif.	Kern	6/77	131	37	15	Amnicola	S	37.0
Chevron	McKittrick	Calif.	Kern	8/83	17	21	8	Tulare	S	36.0
Chevron	McKittrick	Calif.	Kern	6/87	70	25	14	Amnicola	S	37.0
Chevron	McKittrick 6Z	Calif.		4/85	30	29	18	Tulare/Amnicola	S	36.0
Chevron	McKittrick 9Z	Calif.	Kern	8/78	80	27	11	Amnicola	S	38.0
Chevron	Midway-Sunset Sec. 15A	Calif.	Kern	5/78	23	36	5	Potter	S	36.0
Chevron	Midway-Sunset Sec. 25A	Calif.	Kern	6/87	35	14	4	Tulare	S	35.0
Chevron	Midway-Sunset Sec. 26C	Calif.	Kern	11/75	84	243	81	Monarch	S	32.0
Chevron	Midway-Sunset Sec. 2F	Calif.	Kern	10/83	84	44	10	Webster	S	32.0
Chevron	NE. McKittrick 16-Z	Calif.	Kern	9/75	87	42	27	Amnicola	S	35.0
Chevron	West Coalinga	Calif.	Fresno	3/89	100	70	21	Temblor	S	33.0
Chevron	West Coalinga	Calif.	Fresno	7/84	60	40	12	Temblor	S	33.0
Chevron	West Coalinga	Calif.	Fresno	2/82	43	38	10	Temblor	S	33.0
Chevron	West Coalinga 13-D	Calif.	Fresno	5/73	550	182	104	Temblor	S	35.0
Chevron	West Coalinga 25-D	Calif.	Kern	5/80	36	131	95	Temblor	S	29.0
Enercap Corp.	Camp Hill	Tex.	Anderson	4/89	25	23	14	Carrizo	S	37.0
Exxon	Edison	Calif.	Kern	1965	1,100			Kern River	S	28.0
Exxon†	Midway-Sunset	Calif.	Kern		200	100	100	Monarch Sand	S	30.0
Exxon†	South Belridge	Calif.	Kern		90	41	30	Tulare	S	38.0
John Brown E & Co	Teapot Dome NPR-3	Wyo.	Natrona	10/85	120	68	22	Shannon	S	18.0
M.H. Whitter	Midway-Sunset	Calif.	Kern	1965	200	336		Potter	US	35.0
MacPherson Oil Co.	Mt. Poso -West area	Calif.	Kern	5/89	240	40	3	Vedder	US	35.0
Marathon Oil	Garland	Wyo.	Big Horn	5/86	35	6	1	Madison	LS	15.5
Mobil	Bayou Bleu	La.	Iberville	5/88	120	26	7	E.B. Schwing RA SUA	S	30.0
Mobil	Cymric McKittrick Fee	Calif.	Kern	7/65	180	40	0	Welport Amnicola	S	35.0
Mobil	Midway-Sunset	Calif.	Kern	10/70	400	280	0	Monarch	S	34.0
Mobil	North Midway-Sunset	Calif.	Kern	11/67	410	372		Potter	S	35.0
Mobil	San Ardo	Calif.	Monterey	6/68	312	78	16	Aurignac	S	34.5
Mobil	San Ardo	Calif.	Monterey	3/80	84	38	12	Lombardi	S	32.5
Mobil	Saratoga	Tex.	Hardin	6/87	54	10	5	Miocene	S	35.0
Mobil	Sho-Vel-Tum	Okla.	Carter	11/66	55	7	7	Deese Sand	S	26.5
Mobil	South Belridge	Calif.	Kern	1969	870	446	147	Tulare	US	36.8
Mobil	South Belridge	Calif.	Kern	1965	1,987	50		Tulare	US	36.8
Oryx	Cymric	Calif.	Kern	1981	135	55	3	Tulare	S	35.0
Oryx	Midway-Sunset	Calif.	Kern	7/84	49	76	0	Potter	S	28.0
Oryx	Midway-Sunset	Calif.	Kern	3/64	106	225	14	Potter/Tulare	S	35.0
Oryx	Midway-Sunset	Calif.	Kern	1/84		153	0	Potter	S	35.0

Table F

Depth, ft	Reservoir oil			Prev. prod.	Satur. % start	Satur. % end	Proj. maturity	Total prod., b/d	Enh. prod., b/d	Proj. eval.	Profit	Proj. scope
	Gravity, °API	cp	°F.									
1,985	16	15	135		80		Term.	138	80	Disc.	P (Exp. UL)	
2,100	14	93	118	Prim.	70		Term.	646	628	Prom.	Yes	P (Exp. UL)
3,400	9.8	232	145	Prim.	78.8	70	C	1,195	540	Prom.	Yes	RW (Exp. UL)
3,800	11.5	200	160	Prim.	78	63	C	3,955	2,150	Succ.	Yes	P (Exp. L)
2,300	24.5	175	95	WF	72	54	C	100	100	Succ.	Yes	FW
2,460	25	175		WF	76	74	C	60	45	Disc.	No	P (Exp. L)
2,460	24.5	175	95	WF	70	68	C	25	20	Disc.	No	FW
1,200	36	8	73	WF	53	37	C	20	12	Succ.	No	P (Exp. L)
4,900	27	11	136	WF	58	39	Term.	0	0	Disc.	No	Exp. UL

Table G

Permeability, md	Depth, ft	Reservoir oil			Prev. prod.	Satur. % start	Satur. % end	Proj. matur.	Total prod., b/d	Enh. prod., b/d	Proj. eval.	Profit	Proj. scope
		Gravity, °API	cp	°F.									
481	1,225	14.0	1,000	81	Prim.	71		NC	215	215	Succ.		FW
2,000	600	13.0	5,000	78	Prim.	63	15.0	NC	600	600	Succ.	Yes	FW
4,000	1,200	13.0	8,000	90	SS	55	20.0	NC	1,030	950	Succ.	Yes	FW
2,500	900	13.0	7,000	84	Prim.	70	15.0	HF	480	480	Succ.	Yes	FW
2,000	800	13.0	8,000	90	SS	60	15.0	NC	1,100	1,100	Succ.	Yes	FW
1,675	1,200	12.0	2,000	100	SS	65	15.0	HF	450	350	Succ.	Yes	LW
4,000	1,600	11.5	10,000	95	SS	67	15.0	HF	700	500	Succ.	Yes	LW
2,000	1,500	13.0	5,000	10	C	60	30.0	HF	300	200	Succ.	Yes	FW
4,100	1,600	11.5	7,000	95	SS	65	15.0	NC	950	900	Succ.	Yes	LW
2,000	1,300	13.0	5,000	100	SS	60	18.0	JS	600	500	Succ.	Yes	Exp. L
3,700	1,500	11.5	10,000	95	SS	62	15.0	HF	1,200	1,000	Succ.	Yes	LW
1,500	1,200	13.0	3,000	200	SS	50	10.0	HF	2,300	1,400	Succ.	Yes	LW
2,854	1,850	11.5	10,000	95	SS	65	15.0	JS	500	50	TETT		LW
1,500	1,000	13.0	1,500	100	SS	50	10.0	JS	320	75	Succ.	Yes	RW
4,500	1,300	13.0	4,000	90	Prim.	60	35.0	HF	120	100	Succ.	Yes	FW
3,000	1,100	11.4	9,500	130	Prim.	75	57.0	JS	800	250	TETT		Exp. L
2,500	1,200	14.0	1,500	100	Prim.	65		NC	1,150		Succ.	Yes	FW
3,030	1,050	14.0	1,500	95	Prim.	65		NC	70		Disc.	No.	P (Exp. L)
3,000	1,800	12.0	7,500	100	Prim.	62	15.0	JS	1,200	700	Prom.		FW
500	2,800	27.0	6	120	Prim.	55	5.0	HF	350	50	TETT		P
2,900	1,200	12.0	5,500	100	C	51	15.0	JS	1,850	1,650	Succ.	Yes	P
1,800	1,200	13.0	4,000	100		52		NC	3,800	3,800	Succ.	Yes	FW
2,900	1,200	12.0	5,500	100	C	51	15.0	JS	2,500	2,400	Succ.	Yes	Exp. L
2,700	1,300	12.0	3,000	100	Prim.	50		NC	1,600	1,600	Succ.	Yes	FW
	1,000	14.0	2,000	90	Prim.	50		NC	1,600	1,600	Succ.	Yes	FW
	1,400	14.0	2,000	90		65		HF	600	600	Succ.	Yes	FW
2,800	960	14.0	2,000	90	Prim.	59		HF	1,950	1,950	Succ.	Yes	FW
3,389	775	14.0	2,000	90	Prim.	55		HF	8,700	8,700	Succ.	Yes	FW
	850	14.0	2,000	90		60		HF	3,100	3,100	Succ.	Yes	FW
2,800	960	14.0	2,000	90		59		HF	3,900	3,900	Succ.	Yes	FW
	1,000	14.0	2,000	90	Prim.	55		HF	4,800	4,800	Succ.	Yes	FW
2,100	300	14.0	400	75	C	86		JS	410	410	Succ.	Yes	P (Exp. L)
2,000	350	12.0	4,600	90	C	55	20.0	JS	20	20	Disc.	No	P (Exp. UL)
800	550	18.0	300	90	Prim.			HF	280	280	Prom.		
1,000-2,000	1,100	11.3	500	170	SS	60	36.0	NC	610	425	Succ.	Yes	
1,000-2,000	850	11.4	1,000	140	SS	60	27.0	NC	650	545	Succ.	Yes	
1,500	1,100	12.0	300		SF	41	31.0	JS	290		TETT		FW
2,900	1,300	13.0	2,700	100	C	48	15.0	JS	2,600	1,250	Prom.	Yes	P
2,700	1,300	13.0	4,000	100	C	47		HF	410	410	Succ.	Yes	FW
3,900	1,400	14.0	900	120	C	61	20.0	NC	2,650	2,650	Succ.	Yes	P
1,000	1,000	11.0	10,000	90	C	53		JS	400	400	TETT		P
1,100	1,300	14.0	1,500	150	C	58	20.0	HF	7,900	7,900	Succ.	Yes	FW
2,000	1,800	12.0	7,000	90		60		HF	2,300	2,300	Succ.		RW
2,700	1,300	12.0	4,000	100	C	57		HF	510	510	Succ.	Yes	FW
2,300	1,700	13.0	6,000	100	C	44	15.0	JS	1,800	300	TETT		P
2,400	1,500	13.0	5,700	100	C	49	15.0	HF	1,200	1,200	Succ.	Yes	LW
2,400	1,600	13.0	6,000	100	C	50	15.0	HF	800	800	Succ.	Yes	LW
1,000	1,200	13.0	1,000	90	Prim.	46	15.0	NC	3,400	3,400	Succ.	Yes	FW
1,000	2,500	12.0	2,300	100	Prim.	50	12.0	HF	5,800	5,800	Succ.	Yes	FW
2,500	400	18.4	1,200	75	Prim.	50		JS	300	300	Succ.	Yes	LW
1,100	1,100	12.0	8,000	95.0	Prim.			HF	450	450	Succ.	Yes	
2,500	1,500	12.0	11,000	95					600	600	Succ.	Yes	FW
4,000	1,250	13.0	450						1,500	1,500	Succ.	Yes	FW
63	325	33.0	10.00	65	Prim.	50	15.0	NC	775	734	Succ.	Yes	RW (Exp. L)
2,500	1,000-1,500	13.0	2,200	100	Prim.	60	30.0	HF	5,100	5,100	Succ.	Yes	FW
2,000	2,500	17.0	350	105	Prim.	50	20.0	JS	220	100	TETT		LW (Exp. L)
10	4,250	22.0	29	140	Prim.			NC	396	65	Disc.	No	P (Exp. L)
2,000-4,000	1,550	16.0	30	100	Prim.	70		JS	500	400	TETT		RW
3,000	500	13.0	1,500	95	Prim.	87.5	57.7	NC	300	300	Succ.	Yes	FW
4,000	950	13.0	800	85	Prim.	64	53.0	HF	1,600	1,600	Succ.	Yes	FW
1,000	1,000	12.0	2,000	100	Prim.	65	30.0	HF	5,200	5,200	Succ.	Yes	FW
3,000	2,300	12.0	300	130	SS	55	27.0	HF	1,628	1,628	Succ.	Yes	FW
5,000	2,100	11.0	3,000	125	SS	55	27.0	HF	3,129	3,129	Succ.	Yes	P (Exp. L)
3,000	500	15.0	500	74	Prim.	50	20.0	JS	380	380	Prom.	Yes	Exp. L
875	1,500	16.0	939	85	WF	80		JS	200	200	Prom.		P
3,000	1,000	14.0	1,600	95	SS	55.7	18.1	HF	33,500	33,500	Succ.	Yes	Exp. L
3,000	1,000	14.0	1,600	95	Prim.	57	53.6	NC	800	800	Succ.	Yes	Exp. L
1,500	600-1,500	12.0		95	Prim.			HF	1,016	1,016	Succ.	Yes	FW
3,000		12.0	2,300	80	Prim.	80	40.0	HF	648	648	Succ.	Yes	FW
3,000	1,200	12.0			Prim.			HF	7,036	7,036	Succ.	Yes	FW
3,000	1,100	11.0			Prim.			HF	2,203	2,203	Succ.	Yes	FW

Producing thermal EOR in U.S.—continued

Operator	Field	State	County	Start date	Area, acres	– Number wells – Prod.	Inj.	Pay zone	Formation type	Porosity, %
Oryx	Midway-Sunset	Calif.	Kern	1/84	80	106	12	Potter/Marvic/Tulare	US	35.0
Oryx	Midway-Sunset	Calif.	Kern	7/84	70	56	6	Potter	US	35.0
Oryx	Midway-Sunset	Calif.	Kern	8/65	80	195	0	Potter	US	30.0
Oryx	Midway-Sunset	Calif.	Kern	7/84	120	271	0	Potter	US	30.0
Oryx	Midway-Sunset	Calif.	Kern	2/88	90	18	4	Marvic	US	34.0
Oryx	Midway-Sunset	Calif.	Kern	5/64	80	220	0	Potter	S	35.0
Oxy USA	Kern Front	Calif.	Kern	11/81	342	120	8	Etchegoin Chanac	S	33.0
Phillips	Smackover	Ark.	Ouachita	10/71	985	91	5	Nachatoch	S	35.0
Santa Fe Energy	Coalinga	Calif.	Fresno	3/79	160	142	54	Lower Temblor	S	30.0
Santa Fe Energy	Coalinga	Calif.	Fresno	10/89	20	14	6	Lower Temblor	S	30.0
Santa Fe Energy	Coalinga	Calif.	Fresno	10/89	20	23	4	Upper Temblor	S	30.0
Santa Fe Energy	Kern River	Calif.	Kern	9/89	20	31	8	Kern River Series	S	30.0
Santa Fe Energy	Midway	Calif.	Kern	1/85	100	160	25	Potter S.D.	S	30.0
Santa Fe Energy	Midway	Calif.	Kern	1964	900	1,000		Potter Cyc.	S	30.0
Santa Fe Energy	Midway	Calif.	Kern	1970	400	460		Spellacy	S	30.0
Santa Fe Energy	Midway	Calif.	Kern	6/82	800	240		Tulare	S	33.0
Shell	Arroyo Grande	Calif.	San Luis Obispo	1/87	20	35	13	M6	S	31.0
Shell	Belridge	Calif.	Kern	1961	3,489	2,982	683	Tulare	S	36.0
Shell	Cat Canyon	Calif.	Santa Barbara	3/85	1,000			Basal Sisquoc	S	32.0
Shell	Coalinga	Calif.	Fresno	1981	700	150	29	Temblor Zone II	S	30.0
Shell	Coalinga	Calif.	Fresno	1980	550	196	39	Temblor Zone I	S	32.0
Shell	Coalinga	Calif.	Fresno	1984	300	60	8	Temblor Zone II	S	27.0
Shell	Coalinga	Calif.	Fresno	11/87	245	80	30	Etchegoin	S	34.0
Shell	Cymric	Calif.	Kern	12/86	200	124	27	Tulare	S	36.0
Shell	Kern River	Calif.	Kern	1970	600	1,100	225	Kern River Series	S	30.0
Shell	Kern River	Calif.	Kern	9/83	85	35	35	Kern River	S	31.0
Shell	McKittrick	Calif.	Kern	3/88	226	114	30	Tulare	S	36.0
Shell	Midway-Sunset	Calif.	Kern	1/89	5	8	2	San Joaquin	S	33.0
Shell	Midway-Sunset	Calif.	Kern	1979	95	73	0	Upper Spellacy	S	28.0
Shell	Midway-Sunset	Calif.	Kern	1/89	68	76	10	Lower	S	25.0
Shell	Midway-Sunset	Calif.	Kern	1983	143	205	27	Sub-Hoyt	S	31.0
Shell	Midway-Sunset	Calif.	Kern	1971	400	575	35	Potter	US	22-32
Shell	Midway-Sunset	Calif.	Kern	1980	85	130	15	Monarch	S	25.0
Shell	Mount Poso	Calif.	Kern	1971	2,800	253	46	Vedder	S	33.0
Shell	Poso Creek	Calif.	Kern	6/80	360	70	0	Etchegoin	S	33.0
Shell	White Castle	La.	Iberville	8/76	64	30	10	V	S	35.0
Shell	White Castle	La.	Iberville	8/76	31	12	3	U	S	35.0
Shell§	Yorba Linda	Calif.	Kern	7/62	80	76	0	Shallow Tar	S	27.0
Shell	Yorba Linda	Calif.	Orange	1971	310	300	16	Upper Congolomerate	S	22.0
Texaco	Cat Canyon	Calif.	Santa Barbara	1964	1,700	12		S1B	S	31.0
Texaco	Cat Canyon	Calif.	Santa Barbara	1977	390	91		S1A-S6	S	31.0
Texaco	Kern River	Calif.	Kern	8/62	5,070	4,324	1,642	Kern River Series	S	31.0
Texaco	Lost Hills	Calif.	Kern	1977	35	46	11	Etchegoin	S	40.0
Texaco	Lost Hills	Calif.	Kern	1977	49	33	17	Tulare	S	38.0
Texaco	McKittrick	Calif.	Kern	1984	18	15	6	Tulare	S	35.0
Texaco	Midway-Sec 35	Calif.	Kern	1977	27	51	7	Potter	US	35.0
Texaco	Midway-Sec 36	Calif.	Kern	1/89	38	62	11	Potter	US	36.0
Texaco	Midway-North Midway	Calif.	Kern	11/81	77	100	23	Potter	US	30.0
Texaco	Midway-Sec 35	Calif.	Kern	1984	22	34	5	Potter	US	35.0
Texaco	Midway-Security	Calif.	Kern	11/77	36	72	15	Potter	US	33.0
Texaco	San Ardo	Calif.	Monterey	7/87	51	24	7	Lombardi	S	32.0
Texaco	San Ardo	Calif.	Monterey	1965	1,108	53	0	Aurignac	S	39.0
Texaco	Sour Lake	Tex.	Hardin	11/81	26	18	3	Miocene OB-1	S	35.5
Texaco	Sour Lake	Tex.	Hardin	6/84	7	3	2	Miocene OB-4	S	35.0
Texaco	Sour Lake	Tex.	Hardin	3/85	9	2	1	Miocene OB-2	S	33.3
Texaco	Sour Lake	Tex.	Hardin	1/86	6	4	2	Miocene OB-2	S	33.0
Texaco	Sour Lake	Tex.	Hardin	7/89	74	13	2	Miocene OB-3	S	33.0
Texaco	Sour Lake	Tex.	Hardin	10/87	4	6	2	Miocene 700 ft	S	33.0
Union Pacific	Wilmington	Calif.	Los Angeles	4/89	85	38	27	Tar	S	30.0
Unocal	Cymric	Calif.	Kern	1964	300	259	0	Tulare	S	35.0
Unocal	Guadalupe	Calif.	San Luis	1955	2,970	150	0	Sisquoc	S	35.0
Unocal	Midway-Sunset	Calif.	Kern	1974	81	57	17	Potter	S	34.5
Unocal	Midway-Sunset	Calif.	Kern	1983	81	61	0	Tulare	S	31.0
Unocal	Midway-Sunset	Calif.	Kern	6/77	39	60	17	Potter	S	24.0
Unocal	Midway-Sunset	Calif.	Kern	5/69	161	173	0	Potter	S	24.0
Unocal	North Belridge	Calif.	Kern	11/65	160	14	0	Tulare	S	38.0
Unocal	Tensleep	Wyo.	Natrona	5/81	25	9	2	Tensleep	S	18.0
Hot water										
ARCO*	Kern River	Calif.	Bakersfield	1986	50	45	10	Kern River Series	S	31.0
ARCO*	Kern River	Calif.	Bakersfield	1986	28	42	11	Kern River Series	S	31.0
ARCO	Midway-Sunset	Calif.	Kern	8/85	6	6	2	Tulare	S	33.0
Mobil	South Belridge	Calif.	Kern	11/82	242	54	8	Tulare	US	36.8
Santa Fe Energy	Kern River	Calif.	Kern	1/80	150	101	57	Kern River	S	30.0
Texaco	Lost Hills	Calif.	Kern	1/86	11	13	4	Tulare	S	38.0
Texaco	Lost Hills	Calif.	Kern	1/86	38	31	13	Etchegoin	S	40.0
Texaco	McKittrick	Calif.	Kern	1981	12	50	14	Potter	S	35.0
Texaco	San Ardo	Calif.	Monterey	9/86	240	62	24	Aurignac	S	33.0
Combustion										
Bayou State	Bellevue	La.	Bossier	1970	200	85	15	Nacatoch	S	32.0
Chevron	W. Heidelberg	Miss.	Jasper	12/71	362	9	3	Cotton Valley 4 & 5	S	14.0
Greenwich Oil	Forest Hill	Tex.	Wood	9/76	1,900	100	21	Harris Sand	S	28.0
Mobil	Lost Hills	Calif.	Kern	4/61	164	45	7	Tulare	S	42.6
Mobil	Midway-Sunset	Calif.	Kern	1/60	150	32	6	Moco	S	36.0
Mobil	West Newport	Calif.	Orange	1958	300	139	36	Miocene	S	37.0
Santa Fe Energy	Midway-Sunset	Calif.	Kern	1982	24	40	10	Potter	S	32.5
Texaco	Bellevue	La.	Bossier	9/63	385	200	30	Nacatoch	S	33.0

Table G

Permeability, md	Depth, ft	Reservoir oil			Prev. prod.	Satur. % start	Satur. % end	Proj. matur.	Total prod., b/d	Enh. prod., b/d	Proj. eval.	Profit	Proj. scope
		Gravity, °API	cp	°F.									
3,000	1,100	11.0	2,300	95	Prim.			HF	914	914	Succ.	Yes	FW
3,000		12.0	2,300	95	Prim.			HF	603	603	Succ.	Yes	FW
3,000	600	12.0	3,607	110	Prim.	80	20.0	HF	4,657	4,657	Succ.	Yes	FW
3,000	700	12.0	3,607	110	Prim.	80	80.0	HF	5,613	5,613	Succ.	Yes	FW
1,000	1,200	13.0	3,000	104	S	70	15.0	JS	245	245	TETT		P
3,000	1,200	12.0			Prim.			HF	3,734	3,734	Succ.	Yes	FW
3,250	1,300-1,500	14.0	1,525	95	Prim.	50	15.0	JS	1,400	1,400	TETT	Yes	FW
2,000	1,920	20.0	75	110	Prim.	71	50.0	NC	600		Succ.	Yes	FW
100-3,000	850-1,800	14.5	1,900	75	Prim.	35	15.0	NC	1,800	1,500	Succ.	Yes	FW
100-3,000	600-1,300	14.5	1,900	75	Prim.	40	15.0	JS	75	65	TETT		Exp. L
100-3,000	1,100-1,600	14.5	1,900	75	Prim.	40	15.0	JS	100	85	TETT		Exp. L
100-3,000	300-600	13.0	4,000	85	Prim.	45	15.0	JS	250	200	TETT		EXP. L
2,500	1,300	12.0	4,000	100	Prim./C	60	20.0		3,200	1,500	TETT		Exp. L
2,500	1,300	12.0	4,000	100	Prim.	60	33.0		15,200	13,400	Succ.	Yes	FW
2,250	900	11.5	6,500	90	Prim.	60	33.0		4,200	3,300	Succ.	Yes	FW
1,300	1,200	11.0	5,000	100	Prim.	50	43.0		1,200	700	Succ.	Yes	FW
500-800	200-2,000	13-15	2,500-3,000	80-100	Prim.	56		JS	700	550	Prom.	Yes	FW
2,400	400-1,400	13.0	1,900	95	Prim.			HF	88,831	88,831	Succ.	Yes	FW
500-1,000	2,500-4,500	8-12		90-150	Prim.	55		PP			Succ.	Yes	FW
100-500	1,400-1,800	15-20	100-300	80-120	SS			NC	1,300	1,300	Succ.	Yes	FW
200-2,500	825-1,650	11-14	2,000-10,000	84-98	Prim.	60	10.0	HF	3,200	3,100	Succ.	Yes	FW
100-500	1,500-2,000	15-20	100-300	80-120	Prim			JS	900	720	Succ.	Yes	P (Exp. L)
800-1,000	650-1,000	7-12		80-90	Prim.	55		JS	3,300	3,300	Succ.		FW
1,000-2,000	1,000	11-14	1,000-2,000	95-105	Prim.			JS	2,700	2,700	Prom.		LW
500-2,500	150-1,500	11-15		78-85	Prim.			HF	12,200	11,840	Succ.	Yes	FW
2,000	1,200	12.0		81	Prim.	55		PP	400	400	TETT		LW
1,000-2,000	600	10-12		90-100	Prim.			JS	100	100	TETT		LW
	1,200	12.0	2,900	95	SS			JS			TETT		LW
	900	13.0	2,235	90	Prim.			HF	1,050	950	Succ.	Yes	FW
	800	11.6	5,000	90				JS	850	750	Prom.		LW
2,000-3,000	1,080	13.0	3,000	100	Prim.			HF	6,000	5,800	Succ.	Yes	FW
	500-1,400	8.5-14		95	Prim.			HF	11,400	11,400	Succ.	Yes	FW
900	1,300	13.0	2,700	95	SS			HF	6,400	6,300	Succ.	Yes	FW
2,000-10,000	1,800-2,000	15-18	100-500	90-130	Prim.	55	10	NC	14,800	14,800	Succ.	Yes	FW
2,000-4,000	2,300-2,600	10-14	400-800	80-90	Prim			JS	800	500	Succ.	Yes	FW
3,000	1,400	16.0	312	92	Prim.	90		HF	1,490	1,490	Succ.	Yes	RW
3,000	1,100	16.0	145	88	Prim.	90		HF	210	210	Succ.	Yes	RW
1,000	250-1,650	13.0		97	Prim.	95		NC	600	100	Succ.	Yes	FW
500-3,000	500-1,000	10-14		70-100	SS	66		NC	2,300	2,300	Succ.	Yes	FW
3,000	2,300	8.0	100,000	100				NC	30	30	Succ.	Yes	RW
1,400	2,500	7.0	50-10,000	110				NC	1,320	1,320	Succ.	Yes	RW
4,000	1,000	13.0	4,060	90	Prim.	70	30.0	HF	84,600	84,600	Succ.	Yes	FW
2,000	400	13.0	10	250	S	63	30.0	NC	1,100	1,100	Succ.	Yes	FW
2,000	200	13.0	20	220	S	70	30.0	NC	725	725	Succ.	Yes	FW
2,800	1,000	13.0	35	220	S	60	30.0	NC	120	120	Disc.	No	P (Exp. UL)
2,000	1,600	12.0	6,500	230	SS	55	20.0	JS	670	565	TETT	Yes	FW
3,000	1,600	14.0		90	SS	61	21.0	JS	1,560	795	TETT	Yes	P (Exp. L)
3,400	1,000	13.0	1,500	220	S	60	20.0	HF	2,335	1,422	Succ.	Yes	FW
2,000	1,600	12.0	1,500	240	SS	55	20.0	HF	580	440	Succ.	Yes	FW
5,000	950	12.0	1,500	280	S	60	20.0	NC	2,000	1,200	Succ.	Yes	FW
5,500	1,900	11.0	1,200	135	C	58	15.0	JS	1,446	1,446	TETT	No	P (Exp. L)
2,200	2,200	13.0	4,500	100		58	24.0	PP	772	772	Succ.	Yes	RW
1,436	1,000	14.7	665	90	Prim.	53	17.0	NC	163	163	Succ.	Yes	RW
900	1,600	16.2	107	100	Prim.	50	20.0	NC	45	45	Succ.	Yes	RW
1,000	1,200	16.2	100	95	Prim.	50	20.0	NC	35	35	Succ.	Yes	RW
1,000	1,900	13.6	200	106	Prim.	50	20.0	NC	30	30	Disc.	Yes	RW
5,181	1,350	17.0	180	100	Prim.	50	20.0	JS	100		TETT		RW
1,000	1,425	14.5		100	Prim.	50	20.0	JS	32	32	TETT	Yes	RW
2,780	2,563	14.0	283	123	WF	55	20.0	NC	400	400	Succ.		P (Exp. L)
1,000	1,100	13.0			Prim.	65	45.0	NC	8,365	7,070	Succ.	Yes	FW
1,550	3,000	9.0	580	135	Prim.	80	60.0	HF	1,200	700	Succ.	Yes	FW
3,700	1,100	11.4	10,000	110	SS	57.2	32.3	HF	2,530	2,250	Succ.	Yes	FW
1,146	700	11.4	10,000	100	Prim.	54	37.8	HF	420	210	Succ.	Yes	FW
1,500	1,000	11.3	100	220	SS	55	34.0	NC	1,800	1,500	Succ.	Yes	FW
1,500	1,000	11.3	500	170	Prim.	57	35.0	NC	3,300	2,435	Succ.	Yes	FW
2,500	800	13.6	450	130	Prim.	63	49.0	HF	166	66	Prom.	No	FW
500	2,500	14.0	580	90	Prim.	67	30.0	HF	490	300	Prom.	Yes	P
3,000	900	13.5	8,000	90	S	30	20.0	HF	200	130	Succ.	Yes	FW
2,500	600	13.5	5,000	78	S	35	20.0	HF	200	50	Prom.	Yes	FW
2,500	1,000	11.0	24,000	100	SF	20	10.0	NC			Disc.	No	P (Exp. UL)
3,000	1,000	14.0	1,600	95	SF	37.1	28.2	HF	2,200	2,200	Prom.	Yes	P
100-3,000	700	13.0	4,000	85	Prim.	45	15.0	NC	1,600	1,200	Succ.	Yes	FW
2,000	200	13.0	20	250	SF			NC	125	125	Succ.	Yes	P (Exp. L)
2,000	400	13.0	10	250	SF			HF	150	150	Succ.	Yes	P (Exp. L)
4,000	1,100	13.0	40	210	SF	50	30.0	HF	300	30	Disc.	No	P (Exp. UL)
3,000	2,200	13.0	4,000	100	S	38	31.0	JS	650	100	TETT	Yes	RW
650	400	19.0	660		Prim.	94	49.0	HF	420	420	Succ.	Yes	FW
85	11,300	18.0-27.0	6.00	221	Prim.	80		NC	470	470	Succ.	Yes	FW
950	5,000	10.0	1,006	185	Prim.	63	32.0	JS	1,050	1,050	Prom.	No	FW
1,790	300	15.0	410	95	Prim.	63	22.0	NC	520	520	Succ.	Yes	LW
1,500	2,700	14.0	110	125		74	37.0	HF	1,100	1,100	Succ.	Yes	FW
500-1,000	1,600	13.0	750	100	Prim.	86	37.0	HF	980	980	Succ.	Yes	FW
500-4,000	1,700	11.5	2,770	110	Prim.	70		HF	800	700	Prom.	Yes	Exp. L
960	350	19.0	675	130	Prim.	60	28.5	NC	850	850	Succ.	Yes	FW

Producing CO_2, gas EOR in U.S.

Operator	Field	State	County	Start date	Area, acres	No. wells Prod.	No. wells Inj.	Pay zone	Formation	Porosity, %	Permeability, md
CO_2 miscible											
Amoco	Levelland	Tex.	Hockley	3/73	13	2	6	San Andres	Dolo.	11.5	4
Amoco	Lost Soldier	Wyo.	Sweetwater	5/89	1,345	49	66	Tensleep	S	9.9	31
Amoco	Lost Soldier	Wyo.	Sweetwater	5/89	790	31	33	Darwin-Madison	S/LS-Dolo.	10.3	4
Amoco	Slaughter	Tex.	Hockley	1984	6,412	230	79	San Andres	Dolo./LS	10.8	2
Amoco	Slaughter	Tex.	Hockley	12/84	5,700	201	121	San Andres	Dolo./LS	12.0	5
Amoco	Slaughter	Tex.	Hockley	12/84	1,600	70	52	San Andres	Dolo./LS	10.0	4
Amoco	Wasson	Tex.	Yoakum	11/84	7,800	321	282	San Andres	Dolo./LS	9.0	5
Amoco	Wertz	Wyo.	Carbon, Sweetwater	10/86	1,400	58	61	Tensleep	S	10.0	20
ARCO	Sable	Tex.	Yoakum	3/84	825	43	21	San Andres	Dolo.	8.4	2
ARCO	Sho-Vel-Tum	Okla.	Stephens	9/82	1,100	70	41	Sims	S	16.0	70
ARCO	Wasson-Willard	Tex.	Yoakum	1/86	8,000	286	225	San Andres	Dolo.	9.0	1
Chevron	Kingdom Abo	Tex.	Terry	5/85	2,240	59	48	Abo Reef	Dolo.	4.5	8
Chevron	North Ward Estes	Tex.	Ward	3/89	3,840	190	194	Yates	S	16.0	37
Chevron	Pittsburg	Tex.	Camp	6/85	43	4	1	Pittsburg	LS	11.0	2
Chevron	Quarantine Bay	La.	Plaquemines	10/81	57	2	1	4 Sand Reservoir	S	30.0	100-1,000
Chevron	Rangely Weber Sand	Colo.	Rio Blanco	10/86	15,000	130	111	Weber SS	S	12.0	5-50
Chevron	SACROC Unit	Tex.	Scurry	1/72	49,900	732	387	Canyon Reef	LS	3.9	19
Chevron	Timbalier Bay	La.	Lafourche	4/84	37	2	1	S-2B	S	30.0	9,244
Citronelle	Citronelle	Alas.	Mobile	5/81	1,680	42	10	Rodessa	S	10-16	5-75
Conoco	Ford Geraldine Unit	Tex.	Reeves & Culberson	2/81	3,850	91	69	Delaware	S	23.0	64
Conoco	Maljamar	N.M.	Lea and Eddy	1/89	1,200	70	15	Grayburg-San Andres	Dolo/S	10.8	5
Enron Oil & Gas	Twofreds	Tex.	Loving, Ward, Reeves	1/74	4,392	45	36	Delaware	S	19.5	32
Exxon	Cordona Lake	Tex.	Crane	12/85	2,084	29	25	Devonian	Tripol.	22.0	4
Exxon	Means (San Andres)	Tex.	Andrews	11/83	8,500	364	184	San Andres	Dolo	9.0	20
Exxon	Slaughter	Tex.	Hockley	5/85	569	19	11	San Andres	Dolo.	12.5	6
Exxon	Wasson (Cornell Unit)	Tex.	Yoakum	7/85	1,923	58	51	San Andres	Dolo.	8.6	2
George R. Brown	Rose City North	Tex.	Orange	4/81	800	3	5	Hackberry	S	37.0	4,500
George R. Brown	Rose City South	Tex.	Orange	1/83	900	8	5	Hackberry	S	37.0	4,500
Mitchell Energy	Alvord South	Tex.	Wise	1980	2,291	17	17	Caddo	Congl.	12.8	55
Mobil	GMK South	Tex.	Gaines	1982	1,143	31	29	San Andres	LS	9.8	3
Mobil	McElmo Creek Unit	Utah	San Juan	2/85	13,440	155	110	Ismay Desert Creek	LS	14.0	5
Mobil	Slaughter	Tex.	Hockley	6/89	2,495	79	46	San Andres	Dolo	10.3	3
Mobil	Wasson	Tex.	Yoakum	10/85	640	30	26	San Andres	Dolo.	13.0	6
Pennzoil	Tinsley	Miss.	Yazoo	11/81	1,338	15	15	Perry	S	26.4	49
Phillips	Bridger Lake	Utah	Summit	4/70	3,800	7	1	Dakota	S	12.8	79
Phillips	Vacuum	N.M.	Lea	2/81	4,900	192	100	San Andres	Dolo.	11.7	11
Phillips	Maljamar	N.M.	Lea	11/89	40	4	1	Grayburg	S/Dolo.	6.0	0
Santa Fe Energy	Raymond	Mont.	Sheridan	8/83	685	2	1	Nisku	LS	8.2	13
Shell	Crossett (N. Cross)	Tex.	Crane & Upton	4/72	1,500	27	11	Devonian	Tripol.	22.0	5
Shell	Crossett (S. Cross)	Tex.	Crockett	6/88	800	21	10	Devonian	Tripol	21.0	4
Shell	Little Creek	Miss.	Lincoln & Pike	12/85	6,200	56	20	Lower Tuscaloosa	S	23.0	33
Shell	Olive	Miss.	Pike	10/87	1,280	16	6	Lower Tuscaloosa	S	26.0	50
Shell	Wasson (Denver)	Tex.	Yoakum & Gaines	4/83	20,000	780	380	San Andres	Dolo.	12.0	8
Shell	Wasson (South)	Tex.	Gaines	1/86	3,500	100	60	Clearfork	Dolo.	6.0	2
Shell	West Mallalieu	Miss.	Lincoln	11/86	5,760	14	4	Lower Tuscaloosa	S	25.0	20
Stanberry Oil	Farnsworth, North	Tex.	Ochiltree	6/80	1,431	9	5	Marmaton B	LS	11.5	140
Stanberry Oil	Hansford Marmaton	Tex.	Hansford	6/80	2,010	9	10	Marmaton	S	18.1	48
Texaco	Paradis	La.	St. Charles	2/82	347	7	6	Lower 9,000-Ft	S	26.0	770
Texaco	Paradis	La.	St. Charles	2/82	320	1	0	No. 8	S	27.0	795
Texaco	Paradis	La.	St. Charles	1/88	44	1	1	9,500 Ft	S	24.0	252
Union Texas	Wellman	Tex.	Terry	7/83	1,400	32	7	Wolfcamp	LS	9.2	>100.0
Unocal	Dollarhide	Tex.	Andrews	5/85	6,183	83	66	Devonian	Dolo./Tripol	13.5	9
CO_2 immiscible											
Chevron	Timbalier Bay	La.	Lafourche	12/85	422	10		4,900 ft Sand	S	32.0	500-2,500
Marathon Oil	Yates	Tex.	Pecos & Crockett	11/85	14,300	862	23	Grayburg/San Andres	Dolo.	17.0	175
Shell Western E&P	Weeks Island	La.	New Iberia	1/88	480	18	6	S RES A	S	23.0	150-4,000
Shell Western E&P	Weeks Island	La.	New Iberia	1/88	908	8	2	R RES A	S	23.0	100-1,500
Hydrocarbon miscible											
Amoco	Levelland	Tex.	Hockley	5/71	1,422	81	50	San Andres	Dolo.	10.2	2
ARCO	Prudhoe Bay	Alas.		12/82	3,650	42	11	Sadlerochit	S	23.0	300
ARCO	South Pass Block 61	OCS		8/83	55	1	1	1 RK2	S	30.0	25
ARCO	South Pass Block 61	OCS		8/85	54	2	1	LL RBB1, 2	S	30.0	175
ARCO	South Pass Block 61	OCS		5/81	320	8	3	UM RAAO, 2, 3	S	30.0	180
ARCO	South Pass Block 61	OCS		5/81	112	5	2	UM RBB	S	30.0	300
ARCO	South Pass Block 61	OCS		8/83	26	1	1	LL RG	S	33.0	10
ARCO	South Pass Block 61	OCS		8/83	39	1	1	UJ RL	S	33.0	50
ARCO	South Pass Block 61	OCS		5/81	54	4	2	MM RBB	S	30.0	300
ARCO	South Pass Block 61	OCS		10/84	68	3	3	LK2 RU	S	29.0	100
ARCO	South Pass Block 61	OCS		2/84	37	2	1	LL ART	S	30.0	50
ARCO	South Pass Block 61	OCS		5/81	179	7	2	MM RAAO, 2, 3	S	30.0	180
ARCO	West Devil's Pocket	Tex.	Newton	7/87	1,726	6	1	Wilcox 11 500 ft	S	12.3	1
ARCO	Kuparuk River	Alas.		6/88	5,120	30	20	Kuparuk "A" & "C" Sands		25.0	50-1,000
ARCO	Prudhoe Bay	Alas.		2/87	17,200	190	56	Sadlerochit	S	22.0	500
ARCO	Sabine Tram. SW (Wilcox 11500)	Tex.	Newton	12/89	2,010	7	1	Wilcox 11,500 ft	S	14.0	27
Exxon	South Pass Block 89	Tex.		12/83	204	10	10	X and Y Series	S	29.0	100-1,500
Hunt	Fairway	Tex.	Anderson/Henderson	3/66	22,618	95	65	James	LS	12.6	11
Kerr-McGee	North Buck Draw	Wyo.	Campbell	12/88	5,700	11	8	Dakota	S	9.3	3

Table H

Depth, ft	Reservoir oil Gravity, °API	cp	°F.	Prev. prod.	Satur. % start	Satur. % end	Proj. maturity	Total prod., b/d	Enh. prod., b/d	Proj. eval.	Profit	Proj. scope
4,900	30.0	2.30	105	WF	74		NC	28	28	Succ.		P (Exp. L)
5,000	35.0	1.30	178	WF			JS	6,500	4,570	Succ.	Yes	FW
5,400	35.0	1.40	181	WF			JS	2,700	764	Prom.	Yes	FW
4,900	31.0	1.40	105	WF			JS	3,850	1,100	Prom.	Yes	FW
4,950	31.0	1.40	105	WF			JS	9,095	4,015	Succ.	Yes	FW
4,950	31.0	1.40	105	WF			JS	3,900	1,900	Succ.	Yes	FW
5,100	32.0	1.30	110	WF			JS	16,000	8,000	Succ.	Yes	FW
6,000	35.0	1.16	163	WF			HF	10,000	7,200	Succ.	Yes	FW
5,200	32.0	1.46	107	WF			JS	680	380	Succ.	Yes	FW
6,200	25.0	3.30	115	WF	59	42.0	HF	2,140	1,330	Succ.	Yes	LW
5,100	32.0	2.01	110	WF			JS	4,800	1,600	Succ.	Yes	FW
7,500	28.5	3.40	120	WF	58	40.0	JS	2,790		TETT		FW
2,600	35.0	1.40	83	WF	25	10.0	JS	1,730	480	TETT		
8,000	41.0	0.80	205	WF	59		NC	130	100	Succ.	Yes	P (Exp. L)
8,120	32.0	0.99	183	Prim.	33	15.0	NC	125	125	Prom.	No	P (Exp. UL)
5,500-6,500	35.0	1.70	160	Prim./WF	38	29.0	JS	30,700	7,150	Prom.		FW
6,700	41.0	0.35	130	Prim./WF	63.3	46.8	NC	25,540	13,780	Succ.	Yes	FW
7,400	39.0	0.39	180	Prim.	29		HF	250	250	TETT	No	P (Exp. L)
11,000	42.0	46	210	Prim./WF	63		PP	3,300	350	Prom.		Expl. L:
2,680	40.0	1.40	83	Prim./WF	41	35.0	HF	1,500	1,500	Succ.	No	FW
3,650-4,200	37.0	1.00	95		55.6	40.0	JS	1,000		TETT		Exp. L
4,900	36.0	1.50	105	WF			NC	680	680	Succ.	Yes	FW
5,500	40.0	0.50	101	WF			JS	2,100	360	Prom.	Prom.	LW
4,300	29.0	6.00	97	WF			JS			Succ.	Succ.	
4,900	32.0	1.30	110	WF			JS	650	90	TETT		LW
4,500	33.0	1.00	106	WF			JS	2,000	100	TETT		LW
8,200	37.0	2.00	180	WF	50	35.0	NC	160	160	Prom.		FW
8,200	37.0	2.00	180	WF	50	35.0	HF	800	600	Prom.		FW
5,700	44.0	0.39	154	WF	60	52.0	HF	297	80	Prom.	No	FW
5,400	30.0	2.57	101	WF	55	28.0	JS	1,800	300	Succ.	Yes	LW
5,600	41.0	0.50	125	Prim./WF	50		JS	5,450	1,600	Prom.	Yes	FW
5,000	32.0	1.60	107	WF	45	8.0	JS	1,400		TETT	Yes	LW
5,100	33.0	0.97	110	WF	54.4	39.2	NC	1,700	300	Prom.	Yes	FW
4,800	39.0	1.50	175	WF	65	38.0	HF	260	260	Prom.	No	FW
15,600	40.0	0.36	225	Prim.	70	61.0	NC	650	250	Succ.	Yes	FW
4,500	38.0	1.00	101	Prim.	70	50.0	JS	9,000		Succ.	Yes	FW
4,600	36.0	1.10	101	Prim.	60	29.0	JS	40		TETT		P
7,900	40.0	0.40	178	Prim.			HF	85	60	Prom.	Yes	
5,300	44.0	0.36	106		49	21.0	HF	1,934	1,934	Succ.	Yes	FW
5,200	43.0	0.60	104		43	24.0	JS	565		TETT		Exp. L
10,640	39.0	0.40	248	WF	21	2.0	JS	3,900	3,900	Prom.		FW
10,500	39.0	0.34	250	WF	17	2.0	JS	950	950	Succ.	Yes	FW
5,200	33.0	1.30	105	WF	51	30.5	JS	41,100	25,300	Succ.	Yes	FW
6,700	33.0	1.10	105	WF	60		JS	5,800	400	Prom.		FW
10,365	38.0	0.50	245	Prim.	15	1.0	JS	1,500	1,500	TETT		FW
6,400	44.0	1.61	131	WF	57		HF	300	300	Succ.	Yes	FW
6,500	44.0	1.56	142	Prim.	43		HF	420	420	Succ.	Yes	FW
10,400	37.0	0.50	205	Prim.	62	48.0	HF	400	400	Prom.	No	RW
8,600	39.0	0.40	192	Prim.	30	20.0	NC	125	125	Prom.	No	RW
9,800	38.0	35	192	Prim.	45	33.0	HF	100	100	Prom.	No	RW
9,800	43.5	0.54	151	WF	35	10.0	JS	3,600	400	TETT		FW
8,000	40.0	0.44	122	Prim./WF	35	22.0	JS	2,200	400	Prom.		FW
4,878	26.0	1.70	138	Prim.	60		NC	124	95	Prom.	Yes	RW
1,100-1,700	30.0	5.50	82	GI			HF	57,923		Prom.	Yes	FW
14,100	33.0	0.42	242	Prim.	28	5.0	JS			TETT	Yes	RW
13,200	34.0	0.41	241	Prim.	28	5.0	JS			TETT	Yes	RW
4,900	30.0	2.30	105	Prim.	90		HF	2,185	2,185	Succ.		P (Exp. UL)
8,800	27.0	0.90	200	Prim.	65	25.0	JS	50,000	10,000	Prom.		P (Exp. L)
4,900	39.0	0.70	150	Prim.	65	25.0	NC	57	6	Succ.	Yes	FW
5,750	29.0	1.70	158	Prim.	66	28.0	NC	130	55	Succ.	Yes	FW
9,000	41.0	0.38	200	WF	78	25.0	HF	2,800	2,800	Succ.	Yes	FW
6,300	37.0	0.70	165	WF	78	27.0	HF	1,100	400	Succ.	Yes	FW
6,800	43.0	0.40	170	Prim.	73	31.0	NC	37	10	Succ.	Yes	FW
5,500	40.0	0.40	150	Prim.	77	26.0	NC	237	24	Succ.	Yes	FW
6,400	37.0	0.70	165	WF	78	27.0	HF	2,080	1,960	Succ.	Yes	FW
7,900	36.0	0.50	180	Prim.	67	27.0	HF	420	150	Succ.	Yes	FW
8,500	33.0	0.86	190	Prim.	70	30.0	HF	162	41	Succ.	Yes	FW
9,100	38.0	0.30	190	WF	76	26.0	HF	1,650	1,650	Succ.	Yes	FW
11,525	45.9	0.13	266	Prim.	53	24.9	JS/HF	354	167	Prom.		FW (Exp. UL)
5,900		2.00			40-50	25-35		24,000				
8,800	27.0	0.90	200	WF	50	25.0	JS	300,000	10,000	Prom.		FW
11,525	49.0	0.10	271	Prim.	55	15.0	JS	550		TETT		FW (Exp. UL)
11,270	38-40.0	0.40-0.60	165	Prim.	89	73.0	HF	14,000	10,000	Prom.	Yes	RW
9,900	48.0	0.15	260	Prim.	73	36.0	NC	5,110	5,110	Succ.	Yes	FW
12,450	46.0	0.12	282	Prim.	85	35.0	JS	11,000	8,000	Succ.		RW

Producing CO_2, gas EOR in U.S.—continued

Operator	Field	State	County	Start date	Area, acres	No. wells Prod.	No. wells Inj.	Pay zone	Formation	Porosity, %	Permeability, md
Oryx	Fordoche W-12	La.	Pt. Coupee	5/80	3,400	6	0	Wilcox	S	19.0	5
Oryx	Fordoche W-8	La.	Pt. Coupee	5/80	3,300	8	3	Wilcox	S	20.0	9
Oxy USA	Northeast Purdy	Okla.	Garvin	9/82	8,320	106	102	Springer	S	13.0	44
True Oil	Red Wing Creek	N. Dak.	McKenzie	1/82	640	8	1	Mission Canyon	LS	10.0	0.1
Hydrocarbon immiscible											
ARCO	Kuparuk River	Alas.		2/86	30,000	100	85	Kuparuk A & C Sands	S	22.0	50-500
Nitrogen miscible											
Exxon	Blackjack Creek	Fla.	Santa Rosa	2/81	4,600	8	8	Smackover	LS	16.0	112
Nitrogen immiscible											
Chevron	East Painter	Wyo.	Uinta	11/83	1,500	17	7	Nugget	S	11.0	3
Chevron	Painter	Wyo.	Uinta	6/80	1,360	33	13	Nugget	S	11.9	4
Chevron	Stonebluff	Okla.	Wagoner	3/82	540	18	15	Dutcher	S	16.0	200
Exxon	Fanny Church	Ala.	Escambia	1985	600	3	0	Smackover	LS	12.0	5
Exxon	Jay-Little Escambia Crk	Fla/Ala.	Santa Rosa/ Escambia	1/81	14,415	50	30	Smackover	LS	14.0	35
Phillips	Andector	Tex.	Ector	11/81	1,931	20	0	Ellenburger	Dolo.	3.0	100
Phillips	Binger	Okla.	Caddo	1977	12,960	62	30	Marchand	S	7.5	0.2
Unocal	Chunchula Fieldwide Unit	Ala.	Mobile	4/82	23,279	31	8	Smackover Carbonate	Dolo.	12.4	10
Flue gas											
ARCO	Block 31	Tex.	Crane	6/49	7,840	195	98	Devonian	LS	12.0	5
Exxon	Hawkins	Tex.	Wood	4/77	10,590	491	41	Woodbine	S	28.0	3,400
Flue gas immiscible											
Exxon	Hawkins	Tex.	Wood	8/87	2,800	100	6	Woodbine	S	28.0	3,400

Producing chemical EOR projects in U.S.

Operator	Field	State	County	Start date	Area, acres	– Number wells – Prod.	Inj.	Pay zone	Formation type	Porosity, %	Permeability, md
Polymer											
Anderson Oil	North Glo	Wyo.	Campbell	10/87	292	4	2	Minnelusa	S	15.9	150
ARCO	Hamilton Dome	Wyo.	Hot Springs	9/89	80	7	1	Tensleep	S	14.0	58
Cenex	Sage Spring Crk-Unit A	Wyo.	Natrona	8/78	1,456	8	5	Dakota	S	13.0	50
Chevron	N. Stanley	Okla.	Osage	2/76	810	18	11	Burbank	S	18.0	300
Chevron	S. Stanley	Okla.	Osage	6/83	1,280	10	16	Burbank	S	18.0	300
Chevron	W. Bay	La.	Plaquemines	10/81	64	3	2	3A Sand	S	30.0	40
Chevron	W. Bay	La.	Plaquemines	10/81	42	4	1	3A Sand	S	34.0	4,600
Conoco	Vacuum-State #35 Lease	N.M.	Lea	3/83	240	5	10	Grayburg/San Andres	S/LS	10.9	14
Enron Oil & Gas	Isenhour	Wyo.	Sublette	7/80	173	2	3	Almy	S	15.0	1.0-25.0
Enron Oil & Gas	Long Island-Star Corral	Wyo.	Sublette	8/69	173	3	2	Almy	S	15.5	1.0-50.0
Enron Oil & Gas	McDonald Draw #1TB	Wyo.	Sublette	1/72	435	1	1	Almy	S	16.7	2.0-59.0
Enron Oil & Gas	McDonald Draw #4TB	Wyo.	Sublette	7/72	420	10	3	Almy	S	18.0	1.0-200.0
Enron Oil & Gas	Ruben	Wyo.	Sublette	12/70	800	5	4	Almy	S	14.1	1.0-56.0
Enron Oil & Gas	Saddle Ridge Unit	Wyo.	Sublette	12/74	376	8	5	Mesaverde	S	22.0	10.0-95.0
Fina Oil	South Cowden	Tex.	Ector	6/84	666	25	15	Grayburg	Dolo.	10.1	4
Gallagher Drilling	Stewart East Minnelusa Unit	Wyo.	Campbell	7/82	200	4	1	Minnelusa	S	15.6	250
Hunt	East Texas	Tex.	Rusk	8/82	508	76	11	Woodbine	S	22.0	300
Lamamco Drilling¶	Naval Reserve	Okla	Osage	2/82	3,360	121	33	Bartlesville	S	15.8	12
Marathon Oil	Grass Creek	Wyo.	Hot Springs	10/85	740	40	18	Phosphoria/Tensleep	LS/S	21.6	20.0/112.0
Marathon Oil	Ore.Basin-No.Embar Tensleep	Wyo.	Park	11/83	3,000	154	97	Embar/Tensleep	LS/S	20.2	68.0/193.0
Marathon Oil	Oregon Basin-SETPA	Wyo.	Park	1/85	6,108	180	33	Embar/Tensleep	LS/S	15.9	9.0/140.0
Marathon Oil	Kinney Coastal	Wyo.	Park/Big Horn	11/84	1,500	36	23	Tensleep	S	11.2	50
Marathon Oil	Main Consolidated	Ill.	Crawford	7/81	130	11	11	Robinson	S	18.0	115
Marathon Oil	Yates	Tex.	Pecos	12/83	6,900	323	256	Queen Grayburg/ San Andres	Dolo.	15.0	62
Mitchell Energy	Alba Northeast Unit	Tex.	Wood	7/80	410	5	1	Sub-Clarksville	S	21.4	471
Mitchell Energy	Alba SEFB Unit	Tex.	Wood	2/72	731	21	7	Sub-Clarksville	S	23.3	525
Mitchell Energy	Jacksboro S.	Tex.	Jack	5/82	270	5	8	Strawn	S	19.9	86
Natl. Coop. Refinery	Stewart Ranch	Wyo.	Campbell	2/72	1,200	14	14	Minnelusa	S	16.5	92
Oryx	Hitts Lake	Tex.	Smith	10/80		19	7	Paluxy	S	18.9	300
Oxy USA	Harmony Hill	Kan.	Rooks	10/84	130	5	3	Lansing/Kansas City	LS	12.5	
Oxy USA	Hoof	Kan.	Graham	6/82	960	18	8	Lansing/Kansas City	LS	12.0	74.0-113.0
Phillips	North Burbank	Okla.	Osage	9/80	1,440	65	33	Burbank	S	15.5	50
Phillips	South Cowden	Tex.	Ector	9/83	2,050	54	23	Grayburg	Dolo.	11.9	4
Santa Fe Energy	Candy Draw	Wyo.	Campbell	5/87	482	12	1	Minnelusa	S	16.0	
Unocal	Dos Cuadras	Calif.	Santa Barbara	6/83	320	37	10	EP/FP	S	27.0	260.0-680.0
Unocal	Farnsworth	Tex.	Ochiltree	9/83	13,005	37	40	Morrow	S	14.5	22
Unocal	Healdton	Okla.	Carter	12/82	2,010	174	107	Healdton Sands	S	26.2	346
Unocal	Osage-Hominy	Okla.	Osage	4/83	2,880	96	36	Miss. Chat	LS	30.0	27
Western Production	Clareton	Wyo.	Weston	10/85	240	6	1	Newcastle	S	15-18	1-15
Western Production	Mush Creek	Wyo.	Weston	1969	880	4	3	Newcastle	S	15-19	1-15
Micellar-polymer											
Chevron	Berry Hill (Kiefer)	Okla.	Creek	9/82	82	12	21	Glenn	S	20.0	150

Table H

	Reservoir oil											
Depth, ft	Gravity, °API	cp	°F.	Prev. prod.	Satur. % start	Satur. % end	Proj. maturity	Total prod., b/d	Enh. prod., b/d	Proj. eval.	Profit	Proj. scope
13,650	45.0	0.13	274				NC	338	338	Succ.	Yes	FW
13,200	44.0	0.13	267				HF	490	490	Succ.	Yes	FW
9,400	38.0	1.20	148	WF	46	40.0	HF	3,400	2,000	Succ.		FW
9,000	40.0	0.25	241	Prim.	60	20.0	JS	1,200		Succ.	Yes	FW
6,000	24.0	2.20	158	WF	57	54.0	JS	100,000		Prom.	Yes	
15,700	48.0	0.30	286	WF	59		NC	1,280	580	Prom.	Yes	FW
12,000	46.0	0.20	185	HC	98.5	52.0	HF	9,700	3,700	TETT		FW
11,500	46.0	0.20	174	HC	47		HF	3,500	1,450	TETT		FW
1,200	28.0	5.00	85	Prim.	67		NC	48	30			FW
15,565	51.0	0.15	288	Prim.	76		NC	1,000	500	Disc.		FW
15,400	51.0	0.20	285	WF	59	46.0	HF	12,800	11,000	Prom.	Yes	FW
8,835	44.0	0.60	132	Prim.	43.8	37.0	NC	4,420		Succ.	Yes	LW
10,000	38.0	0.30	190	Prim.	76	59.0	HF	2,000	2,000	Succ.	Yes	FW
18,500	54.0	0.18	325	Prim.	80	45.0	JS	8,100	3,000	Succ.	Yes	FW
8,600	46.0	0.30	130	Prim.			NC	7,700	6,300	Succ.	Yes	FW
4,530	24.0	3.70	168	Prim.	88	12.0	NC		11,000	Succ.	Yes	FW
4,600	24.0	3.70	168		35	12.0	JS			TETT	Yes	Exp. L

Table I

	Reservoir oil											
Depth, ft	Gravity, °API	cp	°F.	Previous prod.	Satur. % start	Satur. % end	Project maturity	Total prod., b/d	Enh. prod., b/d	Project eval.	Profit	Project scope
7,900	20.2	29.70	130	Prim	74.4	33.3	HF	726	613	Succ.		FW
2,750	20.0	39	135	WF			JS	350		TETT	Yes	Exp. L.
7,400	36.0	1.40	160	WF	45	21.0	NC	265	130	Succ.	Yes	FW
2,900	36.0	2.36	107	WF	51		NC	300	200	Succ.		FW
2,900	32.0	2.50	165	Prim.	54		NC	190				FW
7,100	41.0	2.30	120	WF	36	32.0	HF					
7,100	30.0	2.40	165	Prim.	65		HF				No	
4,500	37.0	1.30	101	Prim./WF	52	43.0	HF	425		Succ.	Yes	FW
3,600	41.5	1.20	100	Prim.	38.1	27.0	NC	40	10	Succ.	Yes	FW
3,550	44.0	1.20	100	Prim.	43.6	23.9	NC	30	1	Succ.	Yes	FW
3,050	42.0	1.40	90	WF	40	36.7	NC	18	1	Succ.	Yes	FW
3,200	41.8	1.45	95	WF	43.8	29.1	NC	125	7	Succ.	Yes	FW
3,300	43.0	0.95	95	Prim.	42	25.4	NC	120	8	Succ.	Yes	FW
1,800	44.0	2.33	85	Prim.	37.5	27.3	NC	155	10	Succ.	Yes	FW
4,500	35.0	1.90	96-100	WF	57	53.0	HF	1,600	100	Succ.	Yes	LW
8,000	20.0	20.00	124	Prim.	65	37.7	NC	126	100	Succ.	Yes	FW
3,500	37.0	1.90	142	Prim.	57	33.0	NC	530	330	Succ.	Yes	LW
2,650	38.0	3.50	90	WF	27.2	26.7	NC	549	15	Succ.	Yes	FW
4,300/4,500	24.0/24.0	15.00/15.00	105/110	Prim./WF			NC	2,485	920	Succ.	Yes	FW
3,370/3,520	22.5/22.1	8.5/11.0	108/110	Prim./WF	52	40.0	NC	10,900	2,500	Succ.	Yes	FW
3,600/3,840	21.0/21.0	25/15	100	Prim./WF	54	39.0	NC	9,200	3,000	Succ.	Yes	FW
4,240	22.1	11.30	140	Prim./WF			HF	1,581	431	Succ.	Yes	FW
1,100	30.0	18	70	Prim.	51		NC	18	18	Disc.	No	P (Exp. UL)
1,500	30.0	5.50	82	Prim.			NC	12,159		Succ.	Yes	FW
4,100	15.1	75	150	WF	62.6	52.1	NC	38	38	Disc.	Yes	FW
4,200	15.5	75	150	Prim.	69.5	51.8	NC	117	117	Succ.	Yes	FW
1,975	40.0	1.73	100	Prim.	50	22.0	NC	85	85	Succ.	Yes	FW
8,100	20.0	25	136	WF	68	49.0	NC	950	1,013	Succ.	Yes	FW
7,250	26.0	2.71	210	WF			NC	950		Succ.	Yes	FW
3,130	38.6	3.70	105	Prim.	49	34.0	NC	81	81	Succ.	Yes	FW
3,700	41.0	2.30	120	WF	36		NC	75	33		No	FW
2,900	39.0	3.00	120	WF	53	47.0	NC	459	304	Succ.	Yes	FW
4,750	35.0	3.40	96	WF	67	59.0	NC	1,000		Disc.	No	LW
7,300	26.0			Prim.			JS	1,000	1,000	Succ.		
1,280-1,650	25.0-26.0	5-24	95-103	WF	54.0	52-57	NC	2,300	0	Disc.	Yes	FW
7,400	38.0	1	141	WF	43	40.0	HF	573	9	Disc.	Yes	FW
800	30.3	10	80	WF	56	47.0	HF	1,270	72	Succ.	Yes	FW
2,880	38.7	3	100	WF	51	48.0	HF	975	50	Succ.	Yes	FW
6,000	40.0		160	Prim.			NC	16	16	Disc.	No	P
4,400	40.0		115	Prim.			NC	7	7	Succ.	Yes	LW
1,300	39.0	4.40	100	WF	50		NC	350	350	Succ.		LW

Producing chemical EOR projects in U.S.—continued

Operator	Field	State	County	Start date	Area, acres	– Number wells – Prod.	Inj.	Pay zone	Formation type	Porosity, %	Permeability, md
Marathon Oil	Lawrence Robins 102 B Maraflood	Ill.	Lawrence	8/82	25	12	5	Bridgeport	S	21.0	398
Marathon Oil	Lawrence-Robins 202-B Project	Ill.	Lawrence	10/85	1	4	1	Bridgeport Main	S	20.6	352
Marathon Oil	Main Consolidated M-1 Project	Ill.	Crawford	2/77	4[illegible]7	34	27	Robinson	S	19.0	102
Marathon Oil	Main Consolidated M-2 Project	Ill.	Crawford	7/80	331	72	53	Robinson	S	19.0	150
Alkaline											
Conoco	San Miguelito	Calif.	Ventura	11/82	316	16	11	Third Grubb	S	15.1	36
Shell	White Castle	La.	Iberville	9/87	1	2	1	Q RA SU	S	31.0	1,000
Surfactant											
South Fork Inc.*	S. Johnson	Ill.	Clark	6/81	49	36	22	Partlow	S	18.3	302

Tables G, H, I, former operator: *Tenneco †Celeron §Chevron ¶Texaco 'Gary ·DCR "Lawrence Allison

*Completed, terminated U.S. projects**

Operator	Field	State	County	Start date	Area, acres	No. wells prod.	No. wells inj.	Pay zone	Formation	Porosity, %	Permeability, md
Alkaline											
Unocal	Carroll Unit	Tex.	Van Zandt	11/81	212	4	0	Lewisville	S	26.0	100.0
Unocal	South Van Unit	Tex.	Van Zandt	9/80	800	9	4	Lewisville	S	26.0	100.0
CO_2 immiscible											
Chevron	Heidelberg	Miss.	Jasper	12/83	40	1	0	Eutaw	S	25.0	74.0
Chevron	Pittsburg	Tex.	Camp	11/83	40	1	0	Sub-Clarksville	S	23.0	460.0
Exxon	Pewitt Ranch	Tex.	Titus	6/83		1		Paluxy	S	24.0	1,000
Shell	Weeks Island	La.	New Iberia	1978	8	2	1	S RES B	S	26.0	1,800.0
Union Pacific	Wilmington	Calif.	Los Angeles	3/81	41	3	4	Tar	S	24.0	465.0
Union Pacific	Wilmington	Calif.	Los Angeles	2/84	156	10	12	Tar	S	24.0	465.0
CO_2 miscible											
Amoco	Levelland	Tex.	Hockley	8/78	15	1	4	San Andres	Dolo.	11.8	3.8
Amoco	North Cowden Unit	Tex.	Ector	6/85	12	2	6	Grayburg	Dolo. LS	10.0	5.4
ARCO	North Coles Levee	Calif.	Kern	6/81	70	7	1	Stevens	S	19.5	9.0
Chevron	Kurten	Tex.	Brazos	8/81	672	5	4	Woodbine	S	13.0	0.8
Oxy USA	Welch	Tex.	Dawson	2/82	2,675	140	119	San Andres	LS	9.3	9.0
Pennzoil	Richardson	W.V.	Calhoun, Roane	8/86	78	8	4	Berea	S	14.0	40.0
Texaco	Bay St. Elaine	La.	Terrebonne	1/81	9	0	0	8,000 ft	S	32.9	1,480.0
Combustion											
Oxy USA	Bellevue	La.	Bossier	1971	180	186	48	Nacatoch	S	33.9	700.0
HC miscible											
Callon Offshore*	Chandeleur Sound Block 25	La.	St. Bernard	1/83	342	8	3	4,800 ft sand	S	21.3	1,980
Callon Offshore*	Chandeleur Sound Block 25	La.	St. Bernard	1/83	941	40	16	BB	S	33.0	1,680
Hot water											
Texaco	Midway-Sec 35	Calif.	Kern	3/87	10	16	6	Potter	S	35.0	2,000.0
Micellar/polymer											
Oxy USA	Madison	Kan.	Greenwood	8/82	40	15	16	Bartlesville	S	18.9	42.0
Texaco	Salem Consolidated	Ill.	Marion	8/81	60	20	12	Benoist	S	15.4	154.0
Texaco	Sho-Vel-Tum	Okla.	Stephens	8/83	9	3	3	Sims		17.0	83.0
Microbial											
John Brown E&C	Nav Pet. Res. 3-Teapot Dome	Wyo.	Natrona	8/88	188	24	2	Shannon	S	18.0	4-650
Polymer											
American Expl.†	Elaine (San Miguel)	Tex.	Dimmit	12/81	1,260	11	0	San Miguel	S	21.7	6
American Expl.†	Hospah Sand Unit	N.M.	McKinley	1/83	1,061	31	16	Upper Hospah	S	24.7	467
American Expl.†	S. Hospah Lower Oil Pool	N.M.	McKinley	10/83	595	50	13	Lower Hospah	S	27.3	1,282
ARCO	West Nelson Rozet	Wyo.	Campbell	3/84	440	2	2	Minnelusa	S	17.0	170.0
ARCO	West Rozet	Wyo.	Campbell	9/84	120	3	2	Minnelusa	S	17.0	170.0
Beard Oil Co.§	Sleepy Hollow	Neb.	Red Willow	2/85	1,600	41	10	Reagan Sand	S	24.0	2,900
Chevron	C-Bar	Tex.	Crane	6/83	2,600	56	32	San Andres	Dolo.	10.0	6.0
Chevron	Dune	Tex.	Crane	3/82	410	26	14	San Andres	Dolo.	14.0	28.0
Chevron	Goldsmith 5600	Tex.	Ector	9/83	3,840	139	51	Clearfork	Dolo.	15.0	28.0
Chevron	McElroy	Tex.	Crane	10/82	3,200	242	56	Grayburg	Dolo.	13.0	6.0
Chevron	N. Ward Estes	Tex.	Ward	12/81	17,986	785	666	Yates	S	18.0	10.0
Exxon	Camrick	Okla.	Beaver/Texas	1984		43	27	Upper Morrow	S	15.0	
Exxon	Conroe	Tex.	Montgomery	1985				2B	S		5,500
Exxon	Hewitt	Okla.	Carter	3/81	886	85	52	Hewitt	S	21.0	175.0
Exxon	Loudon	Ill.	Fayette	1985		760	554	Chester	S	19.0	
Exxon	Omaha	Ill.	Gallatin	1984		15	4	Chester	S	18.0	20.0-387
Exxon	Roland	Ill.	White/Gallatin	1985		12	8	Chester	S	19.5	13-279
Exxon	Roland	Ill.	White	1985		16	14	Chester	S	15.7	16-626
Exxon	Trapp	Kan.	Russell	1984		15	9	Lansing/Kansas City	LS	18.4	
Exxon	W. Yellow Creek	Miss.	Wayne	9/76	4,813	51	24	Eutaw	S	24.0	112.0
Exxon	Webster	Tex.	Harris	1985		7	3	Frio 1A	S	28.0	206.0

Table I

Depth, ft	Reservoir oil Gravity, °API	cp	°F.	Previous prod.	Satur. % start	Satur. % end	Project maturity	Total prod., b/d	Enh. prod., b/d	Project eval.	Profit	Project scope
950	29.0	18	70	Prim./WF	45		HF	140	140	Prom.	No	P (Exp. UL)
900	29.0	18	70	WF	45		NC	12	12	Prom.	No	P (Exp. UL)
1,000	36.0	6	70	Prim./WF	40		NC	50	50	Prom.	No	FW
1,000	35.0	7	70	Prim./WF	40		HF	65	65	TETT		FW
8,011	31.0	0.70	205	Prim.	70	55.0	HF	1,025		TETT		FW
5,600-5,800	25.0	3.00	135		22	11.0	NC			Succ.		P
475	30.0	20.00	65	WF	46	28.0	PP	36	20	Prom.	Yes	Exp. L

Table J

Depth, ft	Reservoir Oil Gravity, °API	cp	°F.	Prev. prod.	Satur. % start	Satur. % end	Project maturity	Total prod., b/d	Enh. prod., b/d	Proj. eval.	Profit	Project scope
2,600	33.0	2.30	130.0	WF			Term.	5	0	Disc.	Yes	FW
2,600	35.0	2.30	130.0	WF			Term.	50	0	Disc.	Yes	FW
5,060	20.0	15.00	150.0	Prim.			C	24	0	Disc.	No	P (Exp. UL)
3,800	14.0	2,200.00	120.0	Prim.	65.0		C	15	3	Succ.	Yes	P
4,500	19.0	30.00	160.0	Prim.			C			Disc.	No	P
12,760	32.0	0.50	225.0	WF	22.0	2.0	C	0	0	Succ.	No	P.
2,500	14.0	283.00	123.0	WF	51.0	30.0	C	50	50	Succ.	No	P
2,500	14.0	283.00	123.0	WF	51.0	30.0	Term.	250	250	Succ.	No	FW
4,900	30.0	2.30	105.0	WF	43.0		C	0	0	Succ.		P (Exp. L)
4,300	34.0	1.67	94.0	WF			Term.	20	20	Disc.		P
9,000	36.0	0.45	235.0	WF	34.0	25.8	Term.	70	0	Disc.	No	P (Exp. UL)
8,300	38.0	0.40	230.0	Prim.	40.0		C	118	0	Succ.		P
4,890	34.0	2.15	96.0	WF	30.0	18.0	Term.	1,990	100	TETT	No	
2,300	46.0	3.00	80.0	WF	48.0		Term.	80	40	Prom.	No	P
7,400	36.0	0.67	170.0	Prim.	20.0	5.0	C	10	10	Disc.	No	RW
	19.0	676.00	75.0	Prim.	72.0	32.0	C	0	0	Succ.	Yes	FW
4,800	27.0	3.50	120	Prim.	45	30.0	C	379	0	Succ.	Yes	FW
5,450	27.0	3.45	132	Prim.	45	30.0	C	2,104	0	Succ.	Yes	FW
1,600	12.0	38.00	200.0	SF			Term.	400	220	TETT	Yes	P (Exp. L)
1,900	38.0	2.90	97.0	Prim.	34.0		Term.			Disc.	No	P (Exp. UL)
1,750	36.0	36.00	72.0	WF	30.5	15.3	C	110	110	Prom.	No	P (Exp. UL)
7,000	28.0	12.00	135.0	WF	50.0	45.0	C	30	30	Disc.	No	P (Exp. UL)
350	35.0	10.00	65.0	Prim.	45.0	45.0	Term.	391	0	Disc.		P
4,450	36.0	3.00	140		80.2	67.0	Term.	96	0	Succ.	No	FW
1,600	30.0	13.00	95	WF	69	68.2	Term.	148	0	Succ.	No	FW
1,600	24.0	35.00	95	WF	82.5	65.9	Term.	440	0	Succ.	No	FW
8,700	21.0	12.00	197.0	WF			C	100		Disc.		P
8,700	22.0	24.00	170.0	WF			C	70		Disc.		P
3,500	31.0	20.00	95	WF			C	1,600	800	Succ.	Yes	FW
3,500	36.0	5.00	107.0	WF	39.0		C	220	0	Succ.	Yes	FW
3,350	32.0	3.50	95.0	WF	64.0		C	176	0	Succ.	Yes	FW
5,600	32.0	3.50	100.0	WF	49.0		C	1,180	350	Succ.	Yes	FW
2,800	32.0	2.70	88.0	WF	58.0		C	4,600	0	Succ.	Yes	FW
2,800	33.0	1.50	95.0	WF	42.0		C	5,364	0	Succ.	Yes	FW
7,530	39.0	1.50	142.0	WF			C			Disc.	No	
4,900			170.0	Prim.			Term.			Disc.	No	P
2,400	35.0	8.70	96.0	WF	43.0		C			Succ.	Yes	FW
1,800	36.0	6.00	75.0	WF			C			Disc.		FW
1,950	28.0	17.00	78	WF			Term.			Disc.		
3,000	32.0	10.00	83	WF			Term.			Disc.		
3,100	36.0	10.00	87	WF			Term.			Disc.		
3,215	38.0	1.40	97.0	WF			C			Disc.	Yes	LW
4,950	20.0	20.00	150.0	WF	84.0	75.0	C			Succ.		FW
5,900	29.0	1.30	165.0	WF			C			Succ.	No	RW

Completed, terminated U.S. projects—continued

Operator	Field	State	County	Start date	Area, acres	No. wells prod.	No. wells inj.	Pay zone	Formation	Porosity, %	Permeability, md
Fina	Garza	Tex.	Garza	10/82	120	10	5	San Andres	LS	19.8	4.1
Fina	Westbrook	Tex.	Mitchell	12/80	4,740	149	43	Clearfork	Dolo.	7.4	6.3
Graham Resources	Carthage	Okla.	Texas	12/82	1,640	14	9	Morrow	S	19.0	200.0
Lamamco	Naval Reserve	Okla.	Osage	2/82	3,360	90	28	Bartlesville	S	15.8	12.0
Marathon Oil	Byron	Wyo.	Big Horn	12/82	1,500	41	36	Embar/Tensleep	LS/S	13.9	4.5/78
Mitchell Energy	Lucy N.	Tex.	Borden	10/83	550	8	4	Pennsylvanian	LS	9.7	30.0
Mobil	Salt Creek	Tex.	Kent	12/84	12,100	185	92	Canyon Reef	LS	12.0	20.0
Mobil	Vacuum	N.M.	Lea	5/84	320	10	4	San Andres	Dolo.	10.4	3-100.0
Oryx	Fitts	Okla.	Pontotoc	1982	2,030	103	112	Viola	LS	13.8	1-38
Oryx	Stephens County Regular	Tex	Stephens	2/80	3,900	73	73	Caddo	LS	14.2	11.0
Oryx	Stephens County Regular	Tex.	Stephens	2/80	700	10	15	Caddo	LS	14.2	11.0
Oryx	Stephens County Regular	Tex.	Stephens	3/86	3,026	62	78	Caddo	LS	14.0	10.0
Phillips	Vacuum	N.M.	Lea	8/83	320	14	8	San Andres	Dolo.	11.5	17.0
Prima Exploration	C-H	Wyo.	Campbell	8/84	40	3	1	Minnelusa	S	20.6	80
Shell	Big Mineral Creek-Barnes Sand	Tex.	Grayson	12/84	1,065	14	18	Barnes Sand	S	18.5	59.0
Shell	Big Mineral Creek-S Sand Unit	Tex.	Grayson	5/85	1,600	22	14	S Sand	S	13.0	26.0
Texaco	Carthage N.E.	Okla.	Texas	4/83	1,024	7	4	Morrow A	S	18.6	92.0
Texaco	Hewitt	Okla.	Carter	8/82	300	6	5	Hoxbar	S	19.0	270.0
Texaco	Hewitt	Okla.	Carter	4/84	220	8	5	Hoxbar	S	21.0	84.0
Texaco	Hewitt	Okla.	Carter	11/85	100	6	3	Lone Grove	S	18.0	50.0
Texaco	Sho-Vel-Tum	Okla.	Carter	5/85	570	32	22	Deese	S	17.0	70.0
Texaco	Sho-Vel-Tum	Okla.	Carter	2/83	225	14	5	Deese	S	17.0	59.0
Texaco	Sho-Vel-Tum	Okla.	Carter	1/83	1,390	73	34	Hoxbar Deese	S	20.3	200.0
Texaco	Sho-Vel-Tum	Okla.	Stephens	8/81	190	7	4	Deese	S	17.4	216.0
Texaco	Slaughter	Tex.	Cochran	2/84	1,887	33	15	San Andres	Dolo.	11.2	6.0
Texaco	Slaughter	Tex.	Cochran	12/81	7,406	275	90	San Andres	Dolo.	10.7	3.0
Texaco	Vacuum Grayburg-San Andres	N.M.	Lea	7/82	1,486	37	29	Grayburg/San Andres	Dolo.	11.0	18.0
Texaco	Black Diamond	Tex.	Jim Hogg	4/83	200	4	3	Pettus II	S	25.0	212.0
Unocal	Howard Glasscock	Tex.	Howard	1/83	169	12	11	Queen	S	22.0	37.0
Unocal	Southwest Van Unit	Tex.	Van Zandt	9/84	529	18	20	Lewisville	S	26.0	100.0
Steam											
Chevron	Cymric	Calif.	Kern	5/86	26	18	0	Tar	S	32.0	1,200
Chevron	Midway-Sunset. Sec. IF	Calif.	Kern	2/78	19	23	8	Upper 10-10	S	32.0	2,200
Chevron	Tejon-Grapevine	Calif.	Kern	12/78	40	8		Basal Chanac		30.0	2,160
Mobil	Edison	Calif.	Kern	12/81	100	11	0	Kern River	S	30.0	1,000.0
Mobil	Kern Front	Calif.	Kern	5/74	480	43	0	Etchegoin	S	37.0	1,000.0
Texaco	Midway-Reward	Calif.	Kern	2/77	10	36	0	Potter	US	33.0	3,000.0
Texaco	Midway-Santiago Creek	Calif.	Kern	12/83	10	10	4	Tulare	US	34.0	2,500.0
Union Pacific	Wilmington	Calif.	Los Angeles	7/82	20	9	4	Tar	S	30.1	2,780.0
Unocal	Gato Ridge	Calif.	Santa Barbara	1970	130	16	0	Sisquoc Sb & S2	S	32.0	2,500
Unocal	Midway-Sunset	Calif.	Kern	1/85	5	9	4	Potter	S	34.5	3,700
Unocal	South Belridge	Calif.	Kern	3/85	167	12	0	Tulare	S	38.0	4,000.0
Chevron	Cymric 62Z	Calif.	Kern	2/86	30	31	19	Tulare	S	33.0	2,900
Chevron	Lost Hills Sec. 32	Calif.	Kern	2/79	150	29		Etchegoin A	S	36.0	
Chevron	Lost Hills Sec. 32	Calif.	Kern	3/85	18	11	4	Etchegoin A	S	40.0	2,500
Shell	Brea Olinda	Califi.	Orange	6/85	19	20	0	Middle A Sand	S	20.0	50-200
Chevron	Kern Bluff	Calif.	Kern	7/86	214	25		Santa Margarita	S	29.0	2,000
Shell	Midway-Sunset	Calif.	Kern	6/86	110	37	0	San Joaquin	S	33.0	

Former operator:

* ARCO
† Tesoro
§ Amoco

Producing Canadian heavy oil EOR projects

Operator	Field	Province	Start date	Area, acres	– Number wells – Prod.	Inj.	Pay zone	Formation type	Porosity, %
Combustion									
Amoco Canada	Lindbergh Section 18 02 Pilot	Alta.	12/82	10	6	1	Lower Cummings B&C	US	29.0
Amoco Canada	Morgan	Alta.	1/81		35	9	Lloydminster	US	31.5
Electromagnetic									
Mazzei Oil & Gas Ltd.	Frog Lake	Alta.	1/89	640	4		Cummings, McLarin	S	33.0
Steam									
Amoco Canada	Cold Lake	Alta.	1/85	50	16	16	20 meters	US	33.0
Amoco Canada	Soars Lake	Alta.	6/88		16		Sparky	US	33.0
Aostra	Athabasca Oil Sands	Alta.	7/84	2	3	3	McMurray	US	30-35
BP Resources Canada	Wolf Lake	Alta.	4/85	10,130	396	396	Clearwater FM	S	31-33
BP Resources Canada	Wolf Lake	Alta.	1/88	4-6	22	22	L. Grand Rapids FM (B)	S	35.0
Husky Oil	Pikes Peak	Sask.	1/81	240	75	9	Wasaca	US	33.0
Koch Exploration Canada	Fort Kent	Alta.	12/85	160	13		Upper Grand Rapids	S	35.0
Mobil Oil Canada	Iron River	Alta.	3/88	160	20	20	Sparky	S	30-35
Mobil Oil Canada	Iron River/Wolf Lake	Alta.	6/89		1	1	Grand Rapids-Gen. Petr	S	35.0
Murphy Oil	Lindbergh	Alta.	1/74	212	68	68	Lower Grand Rapids	US	33.0
Petro-Canada	Athabasca	Alta.	1/87		1	1	McMurray	US	32.0
Petro-Canada	Athabasca	Alta.	1/85		1	1	McMurray	US	32.0
Shell Canada Ltd.	Peace River	Alta.	10/79	49	24	7	Cretaceous-Bullhead	S	28.0
Shell Canada Ltd.	Peace River	Alta.	10/86	450	163	53	Cretaceous-Bullhead	S	28.0
Amoco Canada	Gregoire (Athabasca)	Alta.	9/85		3	1	McMurray	US	36.4
Esso Resources Canada	Cold Lake	Alta.	1964		1,200	1,200	Clearwater	US	35.0

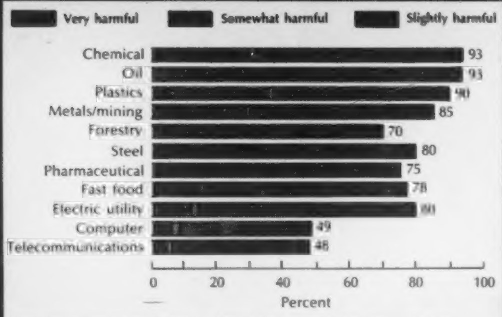
Table J

Depth, ft	Reservoir Oil			Prev. prod.	Satur. % start	Satur. % end	Proj. matur.	Total prod., b/d	Enh. prod., b/d	Proj. eval.	Profit	Project scope
	Gravity, °API	cp	°F.									
2,900	36.0	2.50	90.0	WF	40.0		C	680		Disc.	Yes	P (Exp. UL)
3,000	26.0	9.10	90.0	WF	50.0		C	15			Yes	
4,500	39.0		119.0	Prim./WF	50.0	40.0	C	600	450	Succ.	Yes	FW
2,650	38.0	3.50	90.0	WF	27.2	26.7	C	463	15	Succ.	Yes	FW
5,600	23.0	17.00	121.0	Prim./WF	53.9	50.7	C	2,450	0	Succ.	Yes	FW
7,640	40.0	0.44	140.0	Prim.	52.6	35.7	Term.	95	15	Disc.	No	FW
6,300	39.2	0.85	129.0	WF	60.0	58.0	C	29,000		Succ.	Yes	FW
4,700	37.0	1.02	101.0	Prim./WF	38.0	30.0	C	240			Yes	P (Exp. UL)
3,900	39.0	3.20	119.0	WF			C	2,024		Succ.	Yes	FW
3,300	39.0	1.80	131.0	WF			C	1,555		Succ.	Yes	FW
3,300	39.0	1.80	131.0	WF			C	117		Succ.	Yes	FW
3,200	39.0	3.00	130.0	WF			C	1,031		TETT		FW
4,500	37.0	1.20	101.0	Prim.	74.9	58.2	C	1,000		Succ.	Yes	LW
7,500	20.7	26	135	WF			Term.	94		Prom.		P (Exp. UL)
5,000	37.0	1.50	120.0	WF	50.0	47.0	Term.	300	0	Disc.	No	P (Exp. UL)
5,200	37.9	1.67	124.0	WF	44.0	37.0	Term.	570	0	Disc.	No	FW
4,400	40.0	2.00	113.0	WF	45.0	44.5	C	209	60	Succ.	Yes	FW
2,350	35.0	6.00	98.0	WF	40.0	39.8	C	41	10	Succ.	Yes	FW
2,400	33.0	10.00	94.0	WF	39.0	37.0	C	102	46	Succ.	Yes	FW
4,000	30.0	4.30	115.0	WF	39.0	37.0	C	135	31	Succ.	Yers	FW
3,500	34.0	10.00	110.0	Prim.	57.0	54.6	C	1,059	320	Succ.	Yes	FW
4,400	20-34	4.30	102.0	WF	38.0	37.2	C	94	8	Disc.	Yes	FW
3,100	25.0	20.00	95.0	WF	49.0	47.8	C	1,520	200	Succ.	Yes	FW
5,500	22.0	60.00	124.0	Prim.	64.0	56.0	C	88	29	Succ.	Yes	FW
5,000	31.0	1.47	110.0	WF	53.0	50.0	C	291	0	Disc.	Yes	FW
5,000	31.0	1.47	107.0	WF	49.4	45.6	C	6,150	900	Succ.	Yes	FW
4,720	38.0	1.47	105.0	WF	45.0	44.0	C	3,650	182	Succ.	Yes	FW
4,550	48.0	0.40	164.0	Prim.	68.0	41.0	C	160	178	Succ.	Yes	RW
1,600	32.0	10.00	90.0	WF	50.7	43.4	Term.	62	25	Succ.	Yes	FW
2,600	35.0	2.30	130.0	WF			Term.	475	0	Disc.	Yes	FW
700	11.0	6,500.00	81.0	Prim.	60.0	20.0	C	332	273	Succ.	Yes	FW
1,600	14.0	1,500.00	105.0	C	55.0	15.0	C	100	0	Succ.	Yes	FW
2,600	16.0	167.0	115.0	Prim.			Term.	0	0			
1,100	17.0	800.00	100.0	Prim.	87.0	33.0	Term.	30	20	Succ.	Yes	FW
1,800	14.0	800.00	100.0	Prim.	86.0	67.0	Term.	350	350	Succ.	Yes	FW
1,300	13.0	1,500.00	220.0	S	60.0	20.0	Term.	450	220	Succ.	Yes	FW
1,300	12.0	1,500.00	90.0	S	60.0	20.0	Term.	300	300	Prom.	Yes	Exp. L
2,563	14.0	283.00	123.0	WF	55.0	20.0	C	400	400	Succ.	Yes	P (Exp. L)
1,900	10.5	1,450	130	Prim.	65	49.0	Term.	60	5	Disc.	No	FW
1,100	11.4	10,000	110	SF	52	28.0	C	719	109	Succ.	Yes	P (Exp. L)
1,250	13.2	450.00	130.0	Prim.	66.0	52.0	C	103	0	Disc.	No	FW
1,200	12.0	5,500.00	100.0	C	51.0	15.0	Term.	130	0	Succ.	Yes	FW
1,150	18.0	200.00	90.0	Prim.	72.0		Term.	130	0	Succ.	Yes	
850	14.0	1,400.00	100.0	C	50.0	20.0	Term.	100	0	Succ.	Yes	FW
3,000	13-16	200-600	100-140	Steam soak	49.0		Term.	220	280	Succ.	Yes	FW
950	15.0	1,000.00	84.0	Prim.	74.0		Term.	0	0	Succ.	Yes	
1,200	12.0	2,900.00	95.0	Prim.			Term.	280		Disc.		

Table K

Permea-bility, md	Depth, ft	Reservoir oil			Satur. % start	Satur. % end	Project maturity	Total prod., b/d	Enh. prod., b/d	Project eval.	Profit	Project scope
		Gravity, °API	cp	°F.								
4,000	1,900	11.7	6,500	81	70		HF			Prom.		P
4,400	1,940	12.0	8,100	75	80		HF			Succ.		P FW
	1,800	9-12	10,000	80			HF	220	80	Prom.		Exp. L
1,500	1,500	10.5	500,000	55	80		HF			TETT		P
5,000	1,480	11-13	5-10,000	70	78		JS		11	Disc.	No	P(Exp. UL)
0.1-10	500	8	10,000,000	50	85	15	NC			Succ.	Yes	P
1,000-3,000	1,600	10-12	30-230,000	60-61	54-66		JS	8,175	8,175	Succ.		FW
3,000	380	10	250-1,400,000	61	75		JS			Disc.		P
5,000-10,000	1,640	12	25,000	70	85		HF	4,400	4,400	Succ.	Yes	Exp. L
	1,000	11	21,300		85		HF			Prom.		P
500-2,000	1,150	11.7	40,000	52	65	49	JS	850	850	TETT		P
1,000-4,000	1,250	11	50,000	15	70		JS			TETT		P
2,500	1,600	11	102,500	70	82	65	PP	2,500	2,500	Prom.	Yes	Exp. L
1,000-5,000	1,200	8-9	1,000,000	50	85		NC			Prom.		P
1,000-5,000	1,200	8-9	1,000,000	50	85		NC			Prom.		P
100-2,000	1,800	7.5	100,000	60	80		NC	1,000		Succ.		P
100-2,000	1,800	7.5	100,000	60	80		JS	10,000		Succ.		Exp. L
3,000	615	10	850,000	55	70		HF			Succ.	No	P(Exp. UL)
1,500	1,509	10.2	100,000	55			HF	88,060		Succ.	Yes	FW

Industries' environmental images*



*Data from surveys taken in March 1990. Source: Opinion Research Corp.

BP was training for a crisis such as an oil spill in the weeks before the spill. It had put its new crisis management team through several drills, including a major crisis drill in December 1989 that simulated a alky-feed butane leak from a pipeline that involved a flashback and secondary explosion with civilian casualties. In January, Webster's team went through incident command system (ICS) training in Alaska involving an Alyeska pipeline drill in Valdez. ICS was adapted from an emergency response management approach originated by California firefighters.

"ICS allows you to go, in fire parlance, from a one company response to a multicommunity response while maintaining an organizational structure that allows you to manage a situation. It has an incident commander at the top; an operations section; a planning section; a logistics section; a financial section; and subsets below that to allow you to grow as much as you need to grow and cover everything from air operations to who's going to make sure there is food in the command center to lodging to people who can work skimmers—every phase of the operation."

It helped that the cities most immediately affected by the spill also happened to have crisis management systems based on ICS, helping effective communications.

"What is critically important," said Webster, "is to have local people from the mayor to the police chief to the fire chief to city leaders understand what you are doing to protect the environment. There have been times in the past that that aspect of communications liaison has not worked effectively. In this case, it worked very effectively."

BP sought input from the communities on priorities for beach cleaning, thereby advancing the opening of some beaches.

"This was appreciated by them, and it allowed us to be more sensitive to local community interests."

BP continued the emphasis on local input.

"For instance, in addressing the major beach contamination, there were many options to get oil off the beaches, from manual labor to front loaders. Before making a decision, we talked not only to state and federal officials, we went all the way down to lifeguards who lived on the beach and asked them to fill our heads with as much information about the makeup of the beaches and their history before we made any decisions. One of the key things that we discovered is that there is an erosion history to those beaches. So one of the things we decided to do is go the more manpower, to stay away from heavy machinery to reduce the removal of sand. It caused us to choose technologies such as pom-poms and absorbent sausages that got the oil up without removing a lot of the sand in the process. It was absolutely the right kind of decision for that environment, but one that would have been much more difficult to arrive at had we not taken the organizational approach that we did."

Timing was critical in the response. The BP crisis team was on a plane headed west from Cleveland within 2 hr of notification, which came 30 min after the spill occurred.

"It is BP's policy that whenever there is oil in the water, we send a team with the view that, until we know for sure what caused the oil to be in the water, we will assume there is a hull fracture or something of an equally serious nature," Webster said.

"As a result, we have sent teams out on spills of less than 1 bbl, with the view that we would much rather come back for dinner than to find out that we should have been there sooner."

Before dawn the following morning, top BP officials were being briefed by the Coast Guard and talking to reporters—including an appearance on the Today television program. BP began calling in more than 100 professionals that comprise its crisis response team.

"We also made decision early on that were going to be absolutely available to the media, that we were not going to dodge questions, and that we were not going to try to put any 'spin' on the story," Webster said. "And that meant that when things didn't go well, we put them out with the same gusto that we tried to report successes.

"There was even a point where there was a system set up with state and federal officials to do surveys of the beaches to determine which areas were clean and which areas required additional work. We reached a point where we were finding buried oil in areas where the survey teams declared the beaches clean. So we put out a news relrease that we would like to see a more comprehensive survey. We weren't satsfied that all the oil was being found. It helped to develop credibility with those who were covering the story. And it just served the purpose of presenting ourselves as people who had a good measure of pride and wanted to see the job well done. I don't think that we made any promises that we couldn't keep."

To sum up the philosophy behind BP's crisis response, Webster said, "Information is your biggest ally and your biggest enemy. The more people understand about what you are doing and why you are doing it, the better shape you're in.

"We found in our team just a bunch of very, very skilled people who were within an organizational structure, given a task, and allowed to do it—and the results were very gratifying. There was a lot of pride of ownership in this job. We won some respect from local communities."

BP found a gauge of that respect when it returned a month later to Huntington Beach to throw a dinner for about 100 locals to thank them and tell them it will carry on the process of "lessons learned."

"I couldn't believe it," Webster recounted. "Here we were, in southern California, no less, and here were all these people coming up to us and thanking us for what a wonderful job we did."

The upshot of this effort was that polls of Californians shortly after the spill suggested a majority did not feel especially concerned about an immediate, pressing environmental crisis affecting California. Most today could not even name the American Trader.

The tanker that ran aground at Bligh Reef in Prince William Sound, however, has had to undergo a name change—Exxon Mediterranean, to show its new venue. And the name of the Exxon Valdez, like the Santa Barbara oil spill, will resonate forever to industry's chagrin. IPE

This article was adapted from a chapter of ***U.S. Petroleum Strategies in the Decade of the Environment*** (PennWell Books, 1991) by Bob Williams.

FEDERAL ENERGY REGULATORY COMMISSION officials take testimony from gas producers at a 1990 conference on producer demand charges. FERC is in the forefront of regulatory change in the U.S. designed to boost use of and access to more gas supplies. Photo by Patrick Crow.

2000, according to EIA.

Electric utilities are expected to meet the growth in power demand by completing more than 44 gigawatts (GW) of capacity under construction or announced. Most of that construction will occur in 1991-95, projected EIA. Beyond that, utilities must construct an additional 32-73 GW (base case of 53 GW) of capacity that is currently unplanned. Most unplanned construction, accordingly, will occur in the latter half of the decade.

EIA figured in 1987 that most of the unplanned generating capacity will come from either pulverized coal steam plants (15 GW) or gas-fired/combined-cycle plants (22 GW) built as peak load turbines. Cogeneration power and independent power producers are projected to add almost 30 GW of capacity in the 1987-2000 time frame.

EIA in 1987 figured electric power's fuel mix will break out by 2000 as coal 53%, nuclear 17%, hydro 9%, and oil/natural gas the remainder. The agency estimates oil and gas fired plants' market share will rise from 15% in 1987 to 21% by 2000. By 2000, the combined percentage of generation from oil and gas is expected to exceed that from nuclear power. EIA pegged the total consumption of oil and gas by electric utilities at 3.4 million b/d of fuel oil equivalent from about 1.8 million b/d in 1987.

Bear in mind, these estimates were made shortly after the oil price collapse and before the revival of environmental concerns in 1988-90.

Even in 1988, concerns were arising among the utilities that a capacity shortfall might be in the offing.

In October 1988, the North American Electric Reliability Council warned that "several forces creating risks to the future electricity supply in the United States and Canada must be carefully managed."

The alternative? Soaring costs, draconian conservation measures, controlled brownouts.

"These forces that affect the reliability of electrical supply include a higher than expected growth in the demand for electricity, an imbalance between economy and reliability considerations, public policy disincentives, transmission access and deregulation issues, and environmental considerations..." NERC said.

"Several geographic areas where electric system reliability is at risk are identified...Emergency measures, including controlled interruptions of customers' supply, are possible in these areas."

Underpinning those projections of electric power demand growth are expectations of a healthy economy continuing.

In a 1989 study on North American electric power trends, Arthur Andersen & Co. and Cambridge Energy Associates cited the linkage between economic growth and electric power demand growth.

The study noted that from the end of World War II until the early 1970s, every added U.S. GNP dollar, in constant dollars, inevitably came in tandem with more than 1 kw-hr of electric power sales. That changed dramatically in the 1970s, when the ratio of added kilowatt-hours to increased GNP dollars fell by about half.

But the oil price collapse changed all that, restoring the benefits of low cost energy to the U.S. economy. In 1987 and 1988, electricity sales outstripped GNP growth by about 1.5%/year, according to Andersen/Cambridge.

"If this is evidence of another inflection point in the relationship between electricity sales and economic activity, it has extremely important implications for the utility industry," the study concluded.

"If the pattern that persisted from World War II until the mid-1970s has reappeared, then significant new power plant construction will be needed in the 1990s to avert regional power shortages."

More importantly for power planners, the linkage between economy and power demand remains unbroken, even after energy crises.

Although lagging electric power demand from the mid-1970's to the mid-1980s has been blamed on soaring electricity costs, there is reason to believe that a more significant factor in the falling rate of growth in electricity demand is the stagnant economy that persisted during the same period. That begs a chicken-or-egg proposition, of course, since the same spiraling oil and gas costs that contributed so much to the spike in electricity costs also contributed to depressing other areas of the economy.

If the economy remains healthy and summers prove to be hot and dry in the 1990s, the need to build new power generating capacity in the U.S. will take on a much greater urgency.

Although there was much surplus generating capacity in the 1970s and early 1980s, that won't be the case in the 1990s. Already, annual capacity margins are at their lowest point since the early 1970s. In some parts of the U.S., annual capacity margins are at their lowest levels since

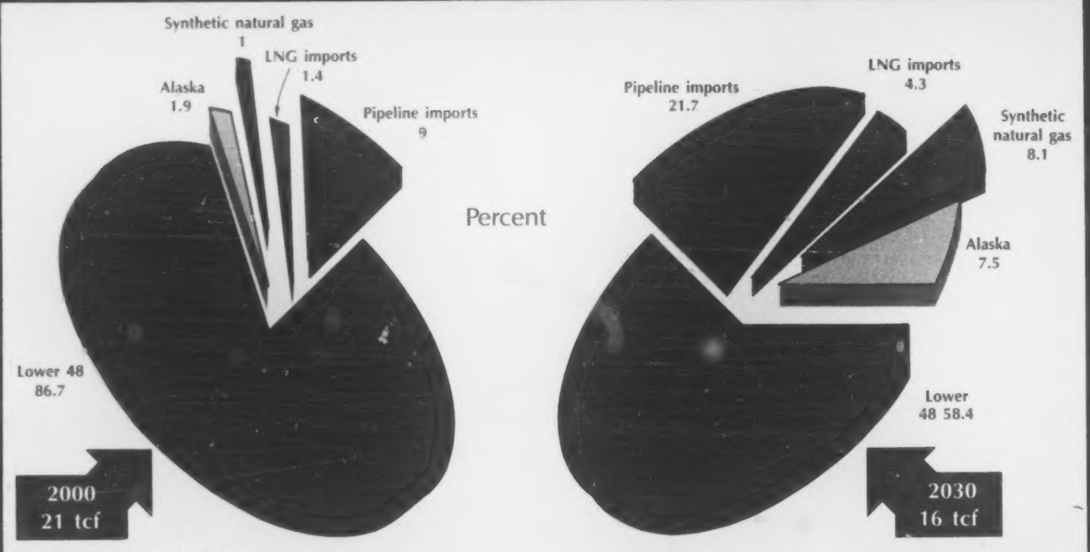
U.S. incremental gas supply potential

	Within 1 year	Within 3 years
	(Bcf)	
Nonproducing reserves	250-750	500-1,000
Canadian gas*	400	500
Accelerated infill drilling	50-100	100-400
LNG†	40-100	200
Total	**740-1,350**	**1,300-2,100**

*Volumes are in addition to 1.283 tcf of imports estimated in 1988.
†Volumes are well below the physical limits of existing terminals.

Source: American Gas Association

U.S. gas supply outlook



Source: Energy Information Administration

the high octane and mileage features.

Currently, only about 5-6% of U.S. propane supplies goes toward use as a motor fuel, according to the Gas Processors Association. More than one third of U.S. propane supplies is used as petrochemical feedstock, mainly because an LPG surplus has kept a lid on propane prices in recent years. Hiking propane use as a motor fuel would place more of a premium on the fuel, raising its price and therefore driving much of the supply out of the petrochemical market and into the motor fuels market.

Surplus gas processing capacity could be put to use as well, doubling U.S. output of propane to 1.7 million b/d. It would not require a massive effort to expand the nation's retail propane marketing network to accomodate nonfleet motorists in the major nonattainment urban areas, as it would for the alcohol fuels.

Infrastructure is a strong argument on behalf of CNG as well. A natural gas pipeline network already extends 1 million miles across the U.S. CNG also has a strong track record, with more than 500,000 CNG vehicles in operation worldwide.

Natural gas may be the best alternative as a motor fuel from an environmental standpoint, say advocates of CNG. Converting existing gasoline or diesel vehicles to natural gas can slash emissions of CO by as much as 99%, NO_x by as much as 85%.

According to the American Gas Association, converting half of the nation's 16 million fleet vehicles could cut U.S. oil consumption by 500,000 b/d, or 5% of total consumption by the transportation sector.

But the natural gas industry has come under some criticism by oil products marketers after AGA stepped up its lobbying efforts in 1989 after passage of the Alternative Motor Fuels Act. The Petroleum Marketers Association of America blasted AGA's efforts to portray natural gas as a "panacea" for U.S. energy and environmental needs. PMAA also claimed that increases in U.S. consumption of natural gas to meet growing motor fuel uses would result in increasing reliance on imports of that fuel, notably in the form of LNG from the Middle East. At the same time, said PMAA, it would take 25% of U.S. gas production to meet 20% of U.S. motor fuels consumption.

That sort of internecine squabbling among different sectors of the petroleum isn't necessarily a harmful thing, if it is simply a case of competing forces battling it out for market share on a level playing field. However, when one segment of the industry seeks preferential treatment, it automatically skews the economics of energy use and just invites more government intervention.

There can be room for all competing petroleum fuels, if they are placed on equal footing. Some competitors may even be of benefit to each other, such as the case with diesel and natural gas. Under EPA strictures, NO_x emissions in new diesel engines must be halved from current levels by 1991. Bus and heavy truck engines will have to cut particulates emissions to one sixth of today's levels by 1994.

Correspondingly, the Gas Research Institute is working on a dual fuel conversion kit for diesel engines that involves using diesel as a sort of pilot light, ignited by the heat of compression and in turn firing the natural gas. At idle and low speeds this kind of diesel engine would run on diesel fuel and at higher speeds on natural gas. That would provide some progress toward meeting future emissions reductions goals without eliminating diesel from the market and mandating costly and inconvenient single fuel alternate fuel engine designs.

Supply concerns

The disappearing gas "bubble," or surplus deliverability, is a cause of concern for electric power producers. Many in the industry surmise that the gas bubble is already effectively gone, as witnessed by the supply curtailments in recent winters in California and elsewhere in the nation.

It is not a question of the potential resource. Although the reserve life of U.S. gas totals more than 20 years at the

U.S. honing technology to burn coal cleanly

COAL IS THE UNITED STATES' MOST ABUNDANT ENergy source, but in this age of environmental awareness one of the most difficult to use.

The U.S. has one fourth of the world's coal reserves, and at current consumption rates its 300 billion tons could last well into the 22nd century.

Since 1973, coal has provided more new energy for the U.S. than any other source. One fourth of all primary energy consumed by the U.S. comes from coal. More than half of the electricity used by American consumers is produced by coal burning power plants.

Per capita, Americans use 19 lb/day of coal, mainly in the form of electricity. Greater coal use by U.S. electrical power plants has saved the equivalent of nearly 3.2 million b/d of oil since 1973.

To help the nation use more coal without harming the environment the Department of Energy has undertaken a $5 billion program to demonstrate full scale projects that burn coal more cleanly and lower power generation costs.

Clean Coal Technology program

Congress launched the Clean Coal Technology (CCT) program in 1986, and President Reagan expanded it in 1987. Under the program, the federal government provides $2.5 billion for coal projects, selected in five rounds of competition, that will be more than matched by private funding.

DOE selected 35 projects to receive federal matching funds in the first three rounds of competition. The projects are valued at more than $3.4 billion.

DOE plans to help finance 50-75 showcase projects by 1992, each demonstrating an advanced method for burning coal cleanly and efficiently. Project costs could total more than $5 billion.

By conducting several rounds of competition, the government hopes to attract the newest and best technologies that will become available as the program proceeds.

The solicitations will demonstrate technology options consistent with demands of the energy market and responsive to environmental considerations.

The projects will provide data on technical, environmental, economic, and operational performance to reduce the uncertainties of later commercial scale use of the technologies.

The technologies to be demonstrated must be capable of being applied to any segment of the U.S. coal resource base and involve new, retrofit, and repowering applications.

The first round focused on new and retrofit applications that, through increased efficiency, can increase the role of coal as an energy option.

The second round concentrated specifically on demonstrating technologies that can overcome barriers to the use of coal created by the issue of acid rain.

Table 1

U.S. clean coal technology funding

Funding round	Fiscal year 1986	1987	1988	1989	1990	1991	1992
	(Million $)						
1	99.4	149.1	149.1				
2	—	—	50	190	135	200	—
3	—	—	—	—	419	156	—
4	—	—	—	—	—	568	—
5	—	—	—	—	—	—	600
Total	**99.4**	**149.1**	**199.1**	**190**	**554**	**924**	**600**

Source: Department of Energy

The third round targeted technologies capable of achieving significant reductions in emissions of sulfur dioxide and/or nitrogen oxide from existing facilities to minimize environmental impacts such as transboundary and interstate pollution and/or provide for future energy needs in an environmentally acceptable manner.

What's planned in the fourth round

DOE planned to announce the CCT fourth round demonstration projects in the fall of 1991. The fifth and final round will be held in 1992.

The fourth round solicitation will focus on innovative technologies that will result in lower greenhouse gas emissions.

Several features have been added to the solicitation that will encourage technologies to help solve U.S. future energy needs.

Another new criterion will rate projects on how the proposed technology can improve the thermal efficiency of utility or industrial facilities in a cost effective way.

DOE said, "More efficient technologies mean lower emissions of pollutants that will have to be offset after a permanent cap on sulfur emissions goes into effect after 2000." It added that increased thermal efficiency also will lower carbon dioxide emissions.

Another change in the solicitation asks sponsors to describe how commercial use of their technology will improve the nation's trade position, create new jobs, or generate revenue.

It permits DOE to protect trade secrets or confidential information for as long as 5 years after a project is completed. If a CCT process were licensed, DOE would receive 5% of the licensing fees or 0.5% of the value of equipment sales.

heavier impurities are separated.

But physical cleaning can remove only matter that is physically distinct from the coal, such as small dirt particles and rocks.

It cannot remove sulfur that is chemically combined with the coal, or nitrogen from the coal.

The advanced CCT techniques will grind the coal into much smaller sizes than is done commercially today, enabling up to 90% of impurities to be removed.

A second method, which may be tested through CCT projects, is through chemical or biological cleaning, such as the molten caustic leaching method.

In that method, coal is exposed to a hot, sodium, or potassium based chemical which leaches sulfur and mineral matter from the coal.

Biological cleaning is being tested in the laboratory, using naturally occurring bacteria or fungi to desulfurize coal.

DOE said chemical or biological coal cleaning appears to be capable of removing as much as 90% of the sulfur and 99% of the ash in coal.

Combustion methods of coal cleaning

Coal also can be cleaned while it is burning, an advantage because additional sulfur or nitrogen removal equipment is not required.

In most conventional coal combustion plants, raw coal is pulverized into particles small enough to form a combustible cloud and injected with hot air into burners along the lower portion of a hollow rectangular box called a steam boiler.

As the coal burns, the heat is transferred to water filled tubes in the sides of the boiler, which create steam that turn a turbine generator.

One of the newer technologies, fluidized bed combustors, uses crushed coal mixed with limestone and suspended on jets of air.

The "bed" of coal and limestone floats and tumbles inside the boiler.

The limestone soaks up the sulfur in the coal, capturing 90% of it.

Combustion temperatures can be held to less than 1,600° F., or almost half the temperature of a conventional boiler, and below the threshold at which nitrogen pollutants form. That allows fludized bed combustors to meet sulfur dioxide and nitrogen oxide standards without additional pollution control equipment.

The CCT program is demonstrating two types of fluidized bed combustors: atmospheric and pressurized methods.

Another advanced technology is the cyclone combustor, which burns coal in a separate chamber outside the furnace

U.S. clean coal projects

Sponsor/ description	Project site	Total cost Million	DOE cost $	DOE share (%)	Status
American El. Power Service Co. Pressurized fluidized bed combustion	Brilliant, Ohio	167.5	60.2	36	1991 start
Babcock & Wilcox Co. Limestone injection multistage burner	Lorain, Ohio	19.4	7.6	39	Operation
Coal Tech Corp. Slagging combustor and sorbent injection	Williamsport,Pa.	980.4	490.2	50	Completed
Energy & Environ. Res. Corp. Gas reburn or sorbent injection	Springfield,Ill.	30	15	50	Construct.
Ohio Clean Fuels Inc. Coal-oil coprocessing liquefaction	Undetermined	225	45	20	Design
Colo.-Ute Electric Assoc. Circulating fluidized bed combustion	Nucla, Colo.	54.1	19.9	37	Operation
Western Energy Co. Western coal cleaning process	Colstrip, Mont.	69	34.5	50	Construct.
Combustion Engineering Coal cleaning	various sites	17.4	8.7	50	Testing
City of Tallahassee, Fla. circulating atmospheric fluidized bed	Tallahassee, Fla.	277	75	27	Design
Amer. El. Pwr. Services Corp. Pressurized fluidized bed combustor	New Haven,W.Va.	660	185	28	Design
Combustion Engineering Inc. Flue gas cleaning	Niles, Ohio	31	16.5	50	Construct.
Babcox & Wilcox Co. Blue gas cleaning	Dilles Bottom,Ohio	10.6	4.8	46	Construct.
Southern Co. Services Sulfur dioxide particulate control	Newman, Ga.	35.8	17.6	49	Construct.
Pure Air Advanced flue gas desfulurization	Chesterton, Ind.	151	63	42	Construct.
Passamaquoddy Tribe Cement kiln flue gas recovery	Thomaston, Me.	12.5	5.9	47	Operation
Bethlehem Steel Corp. Coke oven gas cleaning	Baltimore, Md.	45	13.5	30	Construct.
Southern Co. Services Nitrogen oxide control for wall-fired boiler	Coosa, Ga.	11.7	5.3	45	Operation
Babcox & Wilcox Co. Coal reburning for cyclone boilers	Cassville, Wisc.	10.6	5	48	Construct.

cavity.

The hot combustion gases then pass into the boiler where the heat exchange takes place.

Cyclone combustors keep the ash out of the furnace cavity, where it tends to collect on boiler tubes and lower heat transfer efficiency.

To keep ash from being blown into the furnace, combustion temperature is kept so hot that mineral impurities melt and form slag.

A vortex of air—the "cyclone"—forces slag to the outer walls of the combustor where it can be removed.

But the high temperature required to melt the ash produces unacceptable levels of nitrogen oxide. The CCT program is demonstrating cyclone combustors that overcome that drawback.

DOE said by positioning air injection ports so coal is burned in stages, nitrogen oxide emissions can be reduced 50-70%.

The flue gas scrubber

Until clean coal technologies emerged, the flue gas scrubber, developed in the 1960s, was the only commercial technology capable of achieving the 70-90% sulfur dioxide reduction required under the 1977 Clean Air Act amendments.

Scrubbers are complex chemical plants—separate gas processing facilities installed at the "back end" of a power plant leading to the smokestack.

As of 1988, 146 scrubbers had been installed at 82 of the 370 currently operable coal fired power plants in the U.S. Combined installation and operational costs for the scrubbers exceeded more than $17 billion.

In wet scrubbers, flue gases from combustion of coal are sprayed with a slurry made of water and an alkaline reagent, usually limestone.

The sulfur dioxide in the flue gas reacts chemically with the reagent to form calcium sulfite and calcium sulfate in the form of a wet sludge.

During its lifetime a 500,000 kw, coal fired power plant will produce enough wet sludge to fill a 500 acre disposal pond to a depth of 40 ft, often creating a waste disposal problem.

Wet scrubbers can remove 90% or more of the sulfur dioxide but are expensive to install. They often cost as much as $300/kw of capacity, or $150 million for a typical 500,000 kw plant.

They consume 5-8% of a power plant's thermal energy to run pumps, fans, and a flue gas reheat system, thereby reducing electricity output 1-2%.

They also require large amounts of water, typically 500-

Table 2

Sponsor/ description	Project site	Total cost Million	DOE cost $	DOE share (%)	Status
Southern Co. Services Catalytic reduction of nitrogen oxide	Pensacola, Fla.	15.5	7.5	48	Construct.
Trans-Alta Resources Burner retrofit for cyclone boilers	Marion, Ill.	15.3	6.8	44	Operation
Southern Co. Services Tangentially fired combustion techniques	Lynn Haven,Fla.	8.5	4.1	49	Design
Combustion Engineering Inc. Airblown, entrained flow gasification	Springfield,Ill.	270	129	48	Design
AirPol Inc. Gas suspension absorption system	Paducah, Ky.	6.9	2	29	Design
Air Products & Chemicals Inc. Liquid phase methanol process	Beulah, N.D.	213	93	43	Negotiation
Alaska Ind'l Dev. & Export Auth. Advanced slagging coal combustor	Healy, Alas.	193	94	48	Design
Babcock & Wilcox Co. Low nitrogen oxide cell burner	Aberdeen, Ohio	9.8	4.7	48	Construct.
Bechtel Corp. Utility flue gas sulfur removal	Indiana Cty, Pa.	9.2	4.6	50	Construct.
Bethlehem Steel Corp. Blast furnace granulated coal injection	Burns Harbor, Ind.	143	31	21	Design
Clean Power Cogeneration Inc. Gasification combined cycle	Tallahassee, Fla.	242	121	50	Negotiation
Dairyland Power Cooperative Pressurized circulating fluid bed combustor	Alma, Wisc.	184	88	48	Negotiation
Encoal Corp. Mild gasification to clean coal	Gillette, Wyo.	72	36	50	Construct.
Energy & Env. Research Corp. Combined gas reburning	Denver, Colo.	14.4	7.2	50	Design
Lifac-North America Limestone injection for desulfurization	Richmond, Ind.	17	8.5	50	Construct.
MK-Ferguson Co. Flue gas cleanup system	Niles, Ohio	66.2	33.1	50	Design
Public Service Co. of Colo. Low nitrogen oxide burner demonstration	Denver, Colo.	26	13	50	Design

Source: Department of Energy

Gas production (bcf)

	1990
WESTERN HEMISPHERE	
Arigintina	816.1
Barbados	0.7
Boliva	108.1
Brazil	113.2
Canada	4,267.0
Chile	39.2
Colombia	140.5
Ecuador	3.6
Guatemala	0.3
Mexico	1,332.7
Peru	46.0
Trinidad	177.7
United States	18,358.0
Venezuela	862.0
Total	**26,265.1**
EUROPE	
Austria	41.6
Denmark	101.4
France	106.0
Germany, Fed. Rep.	565.7
Greece	3.1
Italy	736.8
Netherlands	2,618.1
Norway	896.5
Spain	46.3
Turkey	7.5
United Kingdom	1,700.7
Total	**6,823.7**
MIDDLE EAST	
Bahrain	209.9
Iran	854.4
Iraq	140.7
Israel	1.2
Jordan	7.5
Kuwait	147.8
Oman	88.2
Qatar	265.1
Saudi Arabia	1,401.2
Syria	25.8
United Arab Emirates	1,092.1
Total	**4,233.9**
ASIA-PACIFIC	
Afghanistan	10.5
Australia	749.9
Bangladesh	162.4
Brunei	278.6
India	437.7
Indonesia	1,383.2
Japan	57.8
Malaysia	569.7
Myanmar (Burma)	36.5
New Zealand	164.3
Pakistan	451.1
Taiwan, China	38.3
Thailand	212.0
Total	**4,552.0**
AFRICA	
Algeria	1,588.0
Angola	19.0
Egypt	240.0
Gabon	3.6
Libya	202.9
Morocco	1.1
Nigeria	133.9
Tunisia	13.1
Total	**2,201.6**
COMMUNIST	
China	517.7
Romania	1,181.1
USSR	28,800.0
Other	1,032.7
Total	**31,531.5**
WORLD TOTAL	**75,607.8**

*World well completions—1989**

Country	Total wells	Total wildcats
North America		
U.S.	†31,417	5,687
Western Canada	§5,513	2,525
Europe		
Austria	19	12
Denmark	18	4
France	73	47
Greece	4	4
Ireland	5	5
Italy	87	38
Netherlands	73	45
Norway	87	23
Spain	11	10
Svalbard	1	1
Sweden	17	17
Switzerland	1	1
U.K.	212	184
West Germany	-	12
Yugoslavia	135	23
Latin America		
Argentina	801	120
Aruba	2	2
Barbados	9	2
Bolivia	31	13
Brazil	591	115
Chile	53	17
Colombia	208	72
Costa Rica	1	1
Cuba	2	2
Ecuador	29	11
Guatemala	-	4
Mexico	82	24
Panama	3	3
Paraguay	1	1
Peru	86	7
Puerto Rico	1	1
Suriname	59	8
Trinidad & Tobago	85	8
Venezuela	181	23
Middle East		
Abu Dhabi	28	2
Bahrain	20	0
Dubai	24	1
Iraq	-	2
Israel	4	3
Jordan	-	8
Kuwait	10	2
North Yemen	32	12
Oman	-	44
Qatar	11	3
Saudi Arabia	47	3
South Yemen	65	21
Syria	50	20
Turkey	87	39
Southwest Pacific		
Australia	228	63
New Zealand	13	5
Papua New Guinea	23	-
North Africa		
Algeria	78	18
Egypt	114	43
Libya	87	26
Sudan	4	4
Tunisia	11	8
Central, South Africa		
Angola	63	19
Benin	2	1
Cameroon	3	1
Chad	5	5
Congo	10	7
Cote d'Ivoire	1	1
Guinea Bissau	1	1
Gabon	52	26
Ghana	3	3
Kenya	4	4
Mauritania	1	1
Mozambique	1	0
Nigeria	91	47
Senegambia	4	4
Somalia	1	1
South Africa	19	19
Zaire	6	1
Far East		
Bangladesh	4	-
Indonesia	599	102
Japan	11	9
Malaysia	27	17
Pakistan	53	20
Philippines	8	6

*AAPG data; includes stratigraphic and service wells. †Includes 20,851 producers. §Includes 4,094 producers.

International Active Rig Count

Region	1983	1984	1985	1986	1987	1988			1989			1990		
						Land	Off.	Total	Land	Off.	Total	Land	Off.	Total
NORTH AMERICA														
Canada	201	259	311	178	181	194	2	196	129	1	130	138	0	138
United States*	2,229	2,429	1,976	970	936	784	152	936	747	123	870	900	108	1,008
Subtotal	**2,430**	**2,688**	**2,287**	**1,148**	**1,117**	**978**	**154**	**1,132**	**876**	**124**	**1,000**	**1,038**	**108**	**1,146**
LATIN AMERICA														
Argentina	73	82	81	47	61	63	0	63	54	1	55	63	1	64
Bolivia	8	6	5	4	6	5	0	5	6	0	6	6	0	6
Brazil	83	70	76	77	60	28	11	39	21	7	28	16	7	23
Chile	6	6	6	6	7	2	3	5	3	2	5	3	3	6
Colombia	18	16	21	17	14	19	0	19	15	0	15	11	0	11
Costa Rica	1	1	0	0	1	0	0	0	0	0	0	0	0	0
Ecuador	5	4	2	3	3	5	1	6	5	0	5	2	0	2
Mexico	187	196	196	163	143	121	34	155	69	34	103	57	33	90
Peru	16	17	12	13	15	6	5	11	6	4	10	4	2	6
Trinidad	10	9	10	11	9	3	4	7	2	4	6	3	5	8
Venezuela	41	30	33	29	18	15	10	25	18	10	28	20	12	32
Other	3	2	1	1	1	0	0	0	0	0	0	0	0	0
Subtotal	**451**	**439**	**443**	**371**	**338**	**267**	**68**	**335**	**199**	**62**	**261**	**185**	**63**	**248**
FAR EAST														
Australia	25	34	31	15	16	14	5	19	7	7	14	8	6	14
Bangladesh	2	4	5	5	5	2	0	2	4	1	5	4	0	4
Brunei	10	9	7	5	3	1	3	4	1	3	4	1	4	5
China-offshore	10	9	14	7	4	0	8	8	0	4	4	0	3	3
India	56	57	62	70	116	106	25	131	110	25	135	110	27	137
Indonesia	88	82	80	62	37	33	11	44	36	10	46	36	16	52
Japan	20	18	16	15	10	11	0	11	6	0	6	6	1	7
Malaysia	10	9	8	8	8	0	9	9	1	11	12	0	13	13
Myanmar (Burma)	36	33	33	33	29	26	0	26	23	0	23	19	0	19
New Zealand	2	2	4	4	3	1	1	2	2	0	2	0	1	1
Pakistan	17	17	18	17	14	13	0	13	13	0	13	11	0	11
Papua New Guinea	1	1	2	1	2	3	0	3	2	1	3	2	1	3
Philippines	8	3	2	1	2	3	1	4	6	1	7	6	0	6
Taiwan	5	6	7	7	4	2	2	4	4	1	5	2	1	3
Thailand	13	11	9	4	6	3	3	6	3	3	6	2	3	5
Other	0	0	0	0	0	0	1	1	0	1	1	0	1	1
Subtotal	**303**	**295**	**298**	**254**	**259**	**218**	**69**	**287**	**218**	**68**	**286**	**207**	**77**	**284**
AFRICA														
Algeria	54	27	35	41	40	32	0	32	24	0	24	35	0	35
Angola	12	7	11	7	10	0	10	10	1	7	8	1	7	8
Congo	4	3	3	2	3	0	2	2	0	1	1	0	2	2
Gabon	7	6	7	3	3	3	2	5	3	3	6	3	2	5
Kenya	0	0	0	0	1	1	0	1	3	0	3	1	0	1
Libya	24	26	30	20	12	14	2	16	13	4	17	12	3	15
Nigeria	17	11	10	10	11	7	6	13	10	4	14	12	6	18
South Africa	2	2	3	3	3	0	4	4	0	3	3	0	3	3
Tunisia	7	6	4	3	4	2	1	3	3	0	3	2	1	3
Other	20	17	15	8	3	3	2	5	2	2	4	2	0	2
Subtotal	**147**	**105**	**118**	**97**	**90**	**62**	**29**	**91**	**59**	**24**	**83**	**68**	**24**	**92**
EUROPE														
Austria	9	7	7	6	4	4	0	4	2	0	2	1	0	1
Denmark	5	3	4	3	3	0	2	2	0	2	2	0	2	2
France	17	20	22	15	8	8	0	8	7	0	7	6	0	6
Germany	25	19	20	19	12	9	0	9	8	0	8	8	1	9
Greece	3	4	1	0	2	2	0	2	1	0	1	0	0	0
Holland	17	18	24	15	10	4	10	14	4	8	12	3	11	14
Italy	26	26	40	33	26	17	7	24	17	5	22	16	5	21

International Active Rig Count—continued

Region	1983	1984	1985	1986	1987	1988 Land	1988 Off.	1988 Total	1989 Land	1989 Off.	1989 Total	1990 Land	1990 Off.	1990 Total
Norway	10	10	13	12	12	0	15	15	0	12	12	0	12	12
Spain	8	9	10	7	2	1	1	2	1	2	3	1	0	1
United Kingdom	42	60	63	43	44	5	52	57	4	42	46	2	46	48
Yugoslavia	21	25	27	30	31	28	3	31	29	3	32	30	1	31
Other	2	2	2	1	1	0	1	1	0	0	0	0	0	0
Subtotal	**185**	**203**	**233**	**184**	**155**	**78**	**91**	**169**	**73**	**74**	**147**	**67**	**78**	**145**
MIDDLE EAST														
Abu Dhabi	35	29	21	15	9	2	5	7	2	4	6	4	5	9
Dubai	7	7	5	3	2	0	3	3	0	3	3	0	3	3
Egypt	35	36	37	33	23	11	10	21	6	12	18	6	9	15
Iran	13	20	20	18	18	18	0	18	20	0	20	19	0	19
Iraq†	23	19	28	21	10	23	0	23	26	0	26	23	0	23
Jordan	3	3	2	2	2	2	0	2	3	0	3	2	0	2
Kuwait†	5	5	6	6	6	6	0	6	4	0	4	2	0	2
Oman	11	12	13	13	10	9	0	9	13	0	13	17	0	17
Qatar	3	2	3	1	1	2	1	3	1	2	3	1	1	2
Saudi Arabia	26	16	11	6	5	3	1	4	4	1	5	9	1	10
Syria	15	23	26	27	22	24	0	24	24	0	24	17	0	17
Turkey	26	24	25	27	26	20	1	21	20	0	20	17	0	17
Yemen	0	0	1	4	4	3	0	3	2	0	2	3	0	3
Other	4	1	3	2	1	0	0	0	1	0	1	1	0	1
Subtotal	**206**	**197**	**201**	**178**	**139**	**123**	**21**	**144**	**126**	**22**	**148**	**121**	**19**	**140**
Total	**3,722**	**3,927**	**3,580**	**2,232**	**2,098**	**1,726**	**432**	**2,158**	**1,551**	**374**	**1,925**	**1,686**	**369**	**2,055**

*U.S. offshore includes inland water rigs: 30 in 1988, 19 in 1989, 21 in 1990.

†1990 data for Iraq and Kuwait is average rigs January through August.

Source: Baker Hughes Inc.

International seismic crew count

	1985 Land	1985 Marine	1985 Total	1986 Land	1986 Marine	1986 Total	1987 Land	1987 Marine	1987 Total
	(Average crews operating)								
United States	319	45	364	161	22	183	154	24	178
Canada	86	4	90	53	1	54	58	1	59
Mexico	32	0	32	29	0	29	23	0	23
Central & South America	64	8	72	48	5	53	46	5	51
Europe	78	35	113	65	26	91	52	25	77
Middle East	40	2	42	33	4	37	35	3	38
Africa	55	6	61	44	4	48	37	5	42
Far East	92	9	101	74	9	83	87	9	96
Total	**766**	**109**	**875**	**507**	**71**	**578**	**492**	**72**	**564**

	1988 Land	1988 Marine	1988 Total	1989 Land	1989 Marine	1989 Total	1990 Land	1990 Marine	1990 Total
	(Average crews operating)								
United States	147	29	176	109	22	131	104	22	126
Canada	69	1	70	57	1	58	61	1	62
Mexico	21	0	21	17	0	17	17	0	17
Central & South America	53	4	57	53	5	58	53	7	60
Europe	49	26	75	42	25	67	39	24	63
Middle East	42	2	44	41	2	43	38	2	40
Africa	36	6	42	46	8	54	49	8	57
Far East	75	11	86	58	14	72	75	15	90
Total	**492**	**79**	**571**	**423**	**77**	**500**	**436**	**79**	**515**

*First half.
Source: Society of Exploration Geophysicists

Breakout of exploration/production spending*

	1990	1989
	(Million U.S. $)	
MAJORS, U.S.†		
Agip SpA	62	43
Amerada Hess	200	200
Amoco	800	940
ARCO	1,455	1,325
BP	1,000	850
Chevron	1,100	1,100
Du Pont	610	580
Elf Aquitaine	80	100
Exxon	1,400	1,400
Mobil	1,160	1,080
Occidental	250	270
Oryx	330	332
Pennzoil	136	186
Royal Dutch/Shell	1,758	1,573
Texaco	1,000	750
Total Minatome	70	75
Union Pacific	305	241
Unocal	400	400
USX	495	450
SELECTED INDEPENDENTS, U.S.†		
Adobe	76	47
Amax	26	27
American Petrofina	97	75
Anadarko	205	188
Apache	125	80
Arkla	60	60
Ashland	30	30
Beard	35	15
Belden & Blake	24	20
British Gas	50	10
Brooklyn Union	40	27
Burlington Resources	240	260
Cabot Corp.	30	53
Canadian Occidental	39	28
Chieftain	24	14
Coastal	75	75
Coho	33	21
Columbia Gas	100	93
Consolidated Natural	180	200
Dekalb Energy	25	25
Diversified Energies	44	30
Edisto Resources	55	50
Enron	165	170
Enserch	125	86
Equitable Resources	60	55
First Energy	15	25
Forest Oil	77	90
Freeport-McMoRan	150	150
Grace Energy	28	20
Kelley Oil et al.	30	21
Kerr-McGee	130	130
Lasmo	25	18
Louisiana Land	110	100
Maxus Energy	102	102
Mesa Petroleum	50	48
Mitchell Energy	77	73
Murphy	42	45
Nerco	50	25
Nicor	33	30
Noble Affiliates	59	59
Nomeco	48	39
Noranda	42	34
Norcen Energy	51	53
Odeco	68	55
Oneok	14	12
Pacific Enterprises	160	140
PanCanadian	13	13
Petrofina Delaware	35	35
Pogo Producing	36	33
Prairie Producing	50	32
Presidio	35	31
Questar	55	31
Santa Fe Energy	75	75
Seagull Energy	38	24
Seneca Resources	27	19
Sonat	96	78
Southwestern Energy	17	27
Taylor Energy	15	20
Transco Exploration	35	20
Ultramar	45	23
Union Texas	90	90
Wolverine Exploration	30	42
CANADA†		
Alberta Energy	96	80
Amerada Hess	68	65
Amoco	375	300
Anderson	60	28
Bow Valley	71	63
Canada Northwest	10	23
Canadian Occidental	25	34
Chevron	250	250
Columbia Gas	30	28
Co-Enerco	16	14
Dekalb Energy	25	25
Du Pont	40	50
Encor Energy	58	55
Enron	25	20
Gulf Canada	240	214
Imperial	450	428
Mark Resources	46	46
Mobil	175	160
Murphy	30	25
Noranda	164	145
Norcen Energy	114	72
North Canadian	57	62
Numac	23	20
PanCanadian	240	222
PanContinental	23	17
Placer CEGO	32	28
Poco Petroleum	44	39
Renaissance Energy	84	75
Sceptre Resources	48	46
Shell Canada	480	394
Suncor	50	50
Total Petroleum NA	33	31
Union Pacific	33	33
Unocal	70	70
Westcoast	56	52
OTHER INTERNATIONAL†		
Agip SpA	1,613	1,252
Amerada Hess	369	335
Amoco	1,000	785
Ashland Oil	5	20
ARCO	540	490
Bow Valley	103	139
Bridge Oil	18	20
British Gas	468	375
Canadian Occidental	48	22
Chevron	650	650
Clyde Petroleum	72	62
Du Pont	780	740
Elf Aquitaine	1,850	1,450
Enterprise Oil	468	351
Exxon	2,200	2,200
Goal Petroleum	27	30
Gulf Canada	60	34
Hamilton Oil	150	68
Hardy Oil & Gas	35	35
Kerr-McGee	81	81
Lasmo	400	250
Louisiana Land	72	47
Maxus Energy	115	91
Mobil	805	740
Murphy	30	17
Norcen Energy	35	43
Norsk Hydro	585	585
Occidental	400	310
Odeco	35	28
Oryx	120	0
Petrofina	322	343
Premier Consolidated	57	57
Ranger Oil	70	50
Royal Dutch/Shell	3,166	3,166
Saga Petroleum	234	198
Statoil	797	746
Sun Co.	100	100
Texaco	700	400
Total	491	491
Triton Energy	54	54
Ultramar	170	124
Unimar	55	45
Union Texas	150	107
Unocal	280	280
USX	308	280

* Estimates for both years. †Companies spending at least $20 million in either year.

Source: Salomon Bros. Inc.

1989. About 25% of companies said U.S. oil exploration opportunities were good in 1989, compared with 15% in 1988. But a 51% majority still rated oil exploration economics as fair in 1989.

The 71% of all companies that viewed the economics of drilling as more favorable than purchasing reserves was one of the highest percentages in recent years.

The 65% of companies seeking to buy reserves was down slightly from 1989 but still higher than in most recent years. Most companies, particularly U.S. and Canadian companies, preferred to buy gas reserves.

The companies collectively viewed seismic technology advances, most notably three dimensional seismic surveys, as the most important technological innovation in the oil service industry during the previous 2-3 years. Horizontal drilling was the only other advance mentioned by more than 10% of respondents.

Almost all expressing concern cited a shortage of qualified personnel, particularly among roughnecks and floorhands and including qualified reservoir and petroleum engineers, seismic and geophysical professionals, and drilling technicians.

Worldwide oil and gas at a glance

	ESTIMATED PROVED RESERVES 1-1-91		OIL PRODUCTION			REFINING Capacity on 1-1-91				
COUNTRY	Oil (1,000 bbl)	Gas (bcf)	Producing wells* 12-31-89	Estimated 1990 (1,000 b/d)	% change from 1989	No. of ref.	Crude	Thermal operations	Catalytic cracking	Catalytic reforming
								b/cd		
ASIA-PACIFIC										
Australia	1,566,163	15,433	1,024	582.0	18.8	10	705,500	...	205,300	160,900
Bangladesh	500	12,700	10	0.9	...	1	31,200	...	...	1,650
Brunei	1,350,000	11,200	556	143.0	8.0	1	10,000	...	...	...
China	24,000,000	35,300	43,700	2,755.0	0.1	40	2,200,000	...	...	...
China, Taiwan	4,500	700	88	2.5	8.7	2	542,500	17,493	22,600	51,960
India	7,997,100	25,049	1,944	679.0	4.5	12	1,122,360	114,875	136,970	28,233
Indonesia	11,050,000	91,450	6,963	1,274.0	3.5	6	813,600	81,700	12,600	61,500
Japan	63,019	1,124	368	10.5	11.7	41	4,383,400	76,900	629,975	607,970
Korea, North	...	...	...	...	...	1	42,000	...	...	...
Korea, South	...	...	...	...	...	6	867,000	48,700	...	62,450
Malaysia	2,900,000	56,900	508	605.0	6.7	4	209,500	...	...	30,300
Myanmar (Burma)	51,000	9,400	450	13.0	8.3	2	32,000	5,200	...	...
New Zealand	209,000	4,106	51	39.0	1.8	1	95,100	...	...	26,600
Pakistan	162,087	19,449	98	60.0	13.6	3	120,975	...	...	4,800
Papua New Guinea	200,000	8,000	...	...	...	...	...	...	...	...
Philippines	38,688	1,800	12	5.0	−2.0	4	279,300	...	26,900	37,500
Singapore	...	...	...	...	...	5	878,000	190,700	....	63,600
Sri Lanka	...	...	...	...	...	1	50,000	12,500	...	3,750
Thailand	150,000	5,850	287	41.0	2.2	3	220,550	17,600	26,100	27,550
Viet Nam	500,000	100	N A	40.0	100.0	...	....	....	....	....
Total Asia-Pacific	**50,242,057**	**298,561**	**56,059**	**6,249.9**	**4.1**	**143**	**12,602,985**	**565,668**	**1,060,445**	**1,168,763**
WESTERN EUROPE										
Austria	81,443	403	1,070	24.0	9.6	1	204,000	23,426	24,000	32,000
Belgium	...	...	...	...	...	4	602,000	63,500	104,700	81,900
Cyprus	...	...	...	...	...	1	18,600	...	...	4,300
Denmark	799,435	4,488	95	118.0	5.6	3	185,500	73,670	...	31,100
Finland	...	...	..	...	...	2	241,000	46,300	41,800	42,900
France	184,766	1,324	632	62.0	−5.5	14	1,815,630	172,990	349,480	246,760
Germany	425,000	12,400	2,883	78.0	−3.7	20	2,065,400	386,962	240,250	376,500
Greece	30,000	47	13	15.0	−17.6	4	395,300	40,400	59,900	47,000
Ireland	...	1,700	...	...	...	1	56,000	...	...	11,000
Italy	693,503	11,624	198	97.0	16.9	21	2,385,358	390,450	306,300	315,050
Netherlands	157,200	60,900	188	71.0	4.4	7	1,196,700	160,060	128,000	182,600
Norway	7,609,412	60,674	318	1,574.0	6.8	3	288,000	68,000	41,000	47,000
Portugal	...	...	...	...	..	3	294,300	...	10,100	51,000
Spain	20,000	780	44	14.3	−20.6	10	1,321,000	179,500	157,300	191,000
Sweden	...	...	...	...	...	5	427,500	65,000	25,000	72,000
Switzerland	...	...	...	...	...	2	132,000	20,000	...	26,000
Turkey	650,000	1,150	653	70.0	25.0	5	728,644	4,177	40,575	66,557
United Kingdom	3,825,000	19,775	762	1,860.0	4.9	15	1,866,940	146,000	444,500	366,300
Total Western Europe	**14,475,759**	**175,265**	**6,856**	**3,983.3**	**5.6**	**121**	**14,223,872**	**1,840,435**	**1,972,905**	**2,190,967**
EASTERN EUROPE & U.S.S.R.										
Romania	1,170,000	4,700	N A	160.0	−11.1	13	617,000	NA	NA	NA
U.S.S.R.	57,000,000	1,600,000	145,000	11,500.0	−5.3	39	12,300,000	NA	NA	NA
Yugoslavia	240,000	2,900	1,671	65.0	−4.3	7	609,135	35,630	52,050	74,612
Other†	445,000	11,400	N A	81.0	−14.7	25	1,400,454	NA	NA	NA
Total Eastern Europe & U.S.S.R.	**58,855,000**	**1,619,000**	**146,671**	**11,806.0**	**−5.4**	**84**	**14,926,589**	**35,630**	**52,050**	**74,612**
MIDDLE EAST										
Abu Dhabi	92,200,000	182,800	1,001	1,587.0	12.9	2	192,500	...	...	30,100
Bahrain	97,460	6,250	286	42.0	7.7	1	243,000	20,000	39,000	18,000
Dubai	4,000,000	4,800	149	469.0	12.9	...	...	...	...	...
Iran	92,850,000	600,350	361	3,120.0	11.4	5	720,000	92,500	...	105,397
Iraq	100,000,000	95,000	820	2,083.0	−28.1	8	318,500	...	...	43,500
Israel	1,400	10	12	0.3	...	2	180,000	60,000	22,000	25,000
Jordan	20,000	400	4	0.4	...	1	100,000	....	4,410	8,640
Kuwait	94,525,000	48,600	363	1,080.0	−32.2	4	819,000	54,000	42,000	33,000
Lebanon	...	...	...	...	...	2	37,500	...	7,250	7,442
Neutral Zone	5,000,000	10,000	500	315.0	−20.7	...	...	...	...	...
Oman	4,300,000	7,200	1,240	658.0	2.8	1	76,932	...	...	15,386
Qatar	4,500,000	163,200	174	387.0	...	1	62,000	...	...	12,030
Ras al Khaimah	400,000	2,000	6	10.0	...	...	...	...	...	...
Saudi Arabia	257,504,000	180,355	858	6,215.0	24.4	8	1,862,500	71,900	87,541	183,922
Sharjah	1,500,000	10,800	20	35.0	...	...	...	...	...	...
Syria	1,700,000	5,500	963	385.0	13.2	2	237,394	37,285	...	31,352
Yemen	4,000,000	7,000	70	179.0	0.5	2	171,500	...	...	13,300
Total Middle East	**662,597,860**	**1,324,265**	**6,827**	**16,565.7**	**2.7**	**39**	**5,020,826**	**335,685**	**202,201**	**527,069**

COUNTRY	ESTIMATED PROVED RESERVES 1-1-91		OIL PRODUCTION			REFINING Capacity on 1-1-91				
	Oil (1,000 bbl)	Gas (bcf)	Producing wells* 12-31-89	Estimated 1990 (1,000 b/d)	% change from 1989	No. of ref.	Crude	Thermal operations	Catalytic cracking	Catalytic reforming
							b/cd			
AFRICA										
Algeria	9,200,000	114,700	840	797.0	11.2	4	464,700	...	...	55,600
Angola	2,074,000	1,800	439	480.0	6.1	1	37,630	...	...	1,714
Benin	100,000	...	6	4.0	...	...	...	...	...	...
Cameroon	400,000	3,880	175	164.0	−3.0	1	42,000	...	...	7,000
Congo	830,000	2,580	312	161.0	15.6	1	21,000	...	...	2,000
Egypt	4,500,000	12,400	896	873.0	2.6	8	523,153	16,470	...	33,540
Ethiopia	...	880	...	...	...	1	18,000	...	...	2,400
Gabon	730,000	490	310	269.0	27.5	1	24,000	7,200	...	1,400
Ghana	500	...	...	...	...	1	26,600	...	...	6,175
Ivory Coast	100,000	3,500	13	2.1	...	2	69,000	...	...	13,600
Kenya	...	...	...	...	...	1	90,000	...	...	9,000
Liberia	...	...	...	..	...	1	15,000	...	...	2,000
Libya	22,800,000	43,000	696	1,369.0	21.2	3	347,600	...	...	13,882
Madagascar	...	70	...	...	...	1	16,350	7,000	...	2,600
Morocco	2,000	53	5	0.3	...	2	154,600	...	5,600	26,800
Mozambique	...	2,290	...	...	...	...	...	...	...	...
Nigeria	17,100,000	87,400	1,432	1,808.0	8.0	4	433,250	...	82,700	70,070
Senegal	...	...	...	...	...	1	24,000	...	...	2,600
Sierra Leone	...	...	...	...	...	1	10,000	...	...	...
Somalia	...	210	...	...	...	1	10,000	...	...	...
South Africa	...	1,760	...	...	..	4	430,500	72,000	84,400	62,600
Sudan	300,000	3,000	...	...	...	1	21,700	...	...	1,900
Tanzania	...	4,100	...	...	...	1	17,000	...	...	6,700
Tunisia	1,700,000	3,000	147	93.0	−9.7	1	34,000	...	...	3,300
Zaire	55,640	30	110	28.0	−4.8	1	17,000	...	...	3,500
Zambia	...	...	...	...	..	1	24,500	...	...	5,600
Total Africa	**59,892,140**	**285,143**	**5,381**	**6,048.4**	**10.3**	**44**	**2,871,583**	**102,670**	**172,700**	**333,981**
WESTERN HEMISPHERE										
Argentina	2,280,000	27,000	10,161	473.0	3.3	11	696,285	164,100	171,300	41,300
Barbados	3,083	6	88	1.2	9.1	1	3,000	...	...	...
Bolivia	119,182	4,149	296	19.2	−3.5	3	45,250	...	...	11,300
Brazil	2,840,000	4,045	6,267	633.0	7.0	13	1,411,520	39,765	316,585	23,610
Canada	5,782,949	97,589	38,794	1,508.0	−3.2	28	1,882,060	88,978	387,870	367,060
Chile	300,000	4,100	366	20.3	−1.5	3	145,800	19,000	37,870	10,300
Colombia	2,000,000	4,500	3,771	445.0	10.1	4	247,400	60,000	91,000	6,000
Costa Rica	...	...	...	...	...	1	15,000	6,500	...	1,200
Cuba	100,000	100	N A	15.0	−6.3	4	280,000	...	...	...
Dominican Republic	...	...	...	...	...	2	48,000	...	...	9,100
Ecuador	1,420,000	3,950	947	287.0	2.9	5	141,800	25,200	16,000	2,780
El Salvador	...	...	...	...	...	1	16,300	...	...	3,000
Guatemala	36,205	10	14	4.0	2.6	1	16,000	...	...	3,000
Honduras	...	...	...	...	...	1	14,000	...	...	1,800
Jamaica	...	...	...	...	...	1	34,200	...	...	3,240
Martinique	...	...	...	...	...	1	12,000	...	...	3,000
Mexico	51,983,000	72,744	4,740	2,633.0	0.8	9	1,679,000	82,000	267,000	157,800
Netherlands Antilles	...	...	...	...	...	1	320,000	67,000	42,000	15,000
Nicaragua	...	...	...	...	...	1	16,000	...	...	3,000
Panama	...	...	...	...	...	1	100,000	...	...	7,500
Paraguay	...	...	...	...	...	1	7,500	...	...	...
Peru	405,937	7,082	3,536	132.0	...	6	188,820	...	24,600	1,760
Puerto Rico	...	...	...	...	...	2	125,000	...	12,000	25,500
Suriname	27,300	...	124	4.0	5.3	...	...	...	...	...
Trinidad & Tobago	536,000	8,910	3,199	151.0	1.1	2	246,000	8,000	26,000	14,400
Uruguay	...	...	...	...	...	1	33,000	...	4,100	2,500
Venezuela	59,040,000	105,688	12,752	2,118.0	22.4	6	1,167,000	134,100	139,000	6,000
Virgin Islands	...	...	...	...	...	1	545,000	80,000	...	125,000
United States	26,177,000	166,208	603,365	7,220.0	−5.2	190	§15,558,923	§1,972,400	§5,404,100	§3,930,470
Total Western Hemisphere	**153,050,656**	**506,081**	**688,420**	**15,663.7**	**0.5**	**301**	**24,994,858**	**2,747,043**	**6,939,425**	**4,775,620**
TOTAL WORLD	999,113,472	4,208,315	910,214	60,317.0	1.4	732	74,640,713	5,627,131	10,399,726	9,071,012

EDITOR'S NOTE: All reserves figures except those for the U.S.S.R. (and gas for Canada) are reported as proved reserves recoverable with present technology and prices. U.S.S.R. figures are "explored reserves" which include proved, probable, and some possible. Canadian gas figure, under criteria adopted by Canadian Petroleum Association in 1980, includes proved and some probable. *Does not include shut-in, injection, or service wells. †Includes Albania, Bulgaria, Czechoslovakia, Hungary, and Poland. §Estimates based on capacity as of Jan. 1, 1990.

Worldwide Production

• Offshore (e) Estimated (c) Condensate (NA) Not available

WORLDWIDE PRODUCTION

				No. of wells		Production		
		Name of field, discovery date	Depth, ft	Producing	Total	1989 average B/d	Cumulative to Dec. 31, 1989 Bbl	°API gravity
ABU DHABI(e)	ADCO, OTHERS	Asab, 1965	8,000- 8,700	106	248			40.8
		Bab, 1958	8,600- 9,300	100	232			40.6
		Bu Hasa, 1962	8,300- 9,200	201	371			39.0
		Sahil, 1967	9,500- 9,800	22	52			39.7
		• Umm Shaif, 1958	9,800-12,000	142	203			37.0
		• Zakum Lower, 1963	8,000-9,000	131	254			39.0
		• Zakum Upper, 1963	7,000-8,000	142	262			35.0
		• Umm Addalkh, 1969	7,700-8,500	32	54	1,405,600	9,391,306,800	32.5
		• Satah, 1975	8,550-9,500	10	21			39.8
		• Arzanah, 1973	11,000-11,300	14	34			44.6
		• Abu Al Bukhoosh, 1969	8,900-10,900	42	48			32.0
		• Mubarraz, 1969	8,300-10,000	28	28			37.0
		• Bunduq, 1964	9,400-10,900	23	40			40.0
		Total Abu Dhabi		**1,001**	**1,863**	**1,405,600**	**9,391,306,800**	
ALGERIA(e)	SONATRACH	Zarzaitine, 1957	4,700					42.2
		Edjeleh, 1956	1,500- 2,800					37.2
		Tiguentourine, 1966	2,160- 4,265					44.4
		El Adeb Lareche, 1958	4,100					43.3
		Assakaifaf N. & S., 1958	2,800					42.7
		Tan Emellel N. & S., 1960	2,800- 4,500					42.5
		Edeyen, 1964	5,580					41.5
		Hassi Mazoula S., 1963	4,430					40.2
		Hassi Mazoula B., 1965	4,920					42.0
		Acheb W. & Kreb, 1963 & 1960	7,360					45.6
		Tin Fouye N. + F6, 1962	4,265					39.6
		El Borma, 1967	8,200					42.9
		Keskassa, 1968	8,860					42.9
		Mereksen, 1974	9,420					45.8
		Gara, 1962	9,420					42.9
		Hassi Messaoud N., 1956	10,500					45.9
		Hassi Messaoud S., 1956	10,500					46.1
		Gassi-Touil & Gassi-Touil E., 1961	6,890					50.6-50.8
		Hassi Chergui	8,200					50.6
		Nezla N., 1965	8,530					51.5
		Rhourde El Baguel, 1962	9,850					40.2
		Mesdar E. & W., 1972	11,155					40.3
		El Gassi-El Agreb, 1959	10,170	840	840	714,000	8,032,996,000	47.9
		Rhourde Nouss & E., 1972	8,530					39.7
		Tin Foye Tabankort, 1966	4,600- 6,560					41.1-41.3
		Djoua W., 1967	5,580- 6,240					41.1
		Amassak, 1970	6,565					41.1
		Tamendjelt, 1970	5,585- 6,890					41.1
		Timedratine, 1964	8,155					42.7
		Ohanet N. & S., 1960	7,878					43.8
		Askarene, 1962	8,200					41.7
		Guelta, 1962	8,960					41.7
		Stah, 1971	9,515					45.8
		Ras Toumb, 1976	9,190					35.7
		Haoud Berkaoui-Ben Kahla, 1965	11,000					43.6
		Guellala-Guellala N.E., 1969	11,320					42.2-42.3
		N'Goussa, 1974	11,715					42.2
		Kef El Argoub, 1973	12,570					42.2
		Oued Noumer, 1969	8,860					48.3
		Djorf, 1974	9,025					48.3
		Djebel Onk, 1960	3,940					37.0
		Alrar FJT	...					...
		Hassi R'Mel(c)	...					...
		Gassi Touil(c)	...					...
		Total Algeria		**840**	**840**	**714,000**	**8,032,996,000**	
ANGOLA	FINA ANGOLA	Benfica, 1955	8,300	2	15	22	2,272,000	30.0
		Bento, 1972	7,350	1	5	225	5,075,000	36.0
		C. Cobra, 1969	4,000	11	15	1,056	3,795,000	41.0
		Cacuaco, 1958	7,870	1	12	38	279,000	30.0
		Galinda, 1959	7,220	...	8	...	2,245,000	30.0
		Ganda, 1975	5,000	8	9	4,096	8,497,000	36.0
		Legua, 1972	6,300	1	3	96	732,000	31.0
		Luango, 1977	3,800	3	6	955	2,555,000	38.0

		Name of field, discovery date	Depth, ft	No. of wells Producing	No. of wells Total	Production 1989 average B/d	Production Cumulative to Dec. 31, 1989 Bbl	°API gravity
		Lumueno, 1977	4,600	9	13	2,341	5,610,000	37.0
		Mulenvos, 1966	5,900- 6,600	7	16	267	5,750,000	25.0
		N'Zombo, 1973	5,000- 6,300	24	41	9,882	95,213,000	33.0
		Pambo, 1982	4,600	4	5	1,096	2,434,000	39.0
		Pinda, 1966	6,709	...	4	...	3,000	26.0
		Quenguela, 1968	6,000	26	68	1,164	38,058,000	31.0
		Quinfuquena, 1975	6,800- 7,100	14	19	4,223	27,428,000	32.0
		Quinguila, 1972	3,400	18	58	7,375	38,732,000	36.0
		Sereia, 1974	6,200	2	4	812	1,735,000	27.0
		Tobias, 1961	1,970	1	6	50	28,846,000	31.0
	CHEVRON	● Kali, 1969	11,400-11,660	1	1	120	4,334,230	30.0
		● Kambala, 1971	10,500	4	5	5,430	21,778,134	32.8
		● Kungulo, 1975	4,000	16	17	9,846	50,196,610	32.2
		● Lifuma, 1984	7,800	...	1	15	205,368	31.4
		● Limba, 1969	2,660- 7,350	10	14	10,542	92,672,296	31.6
		● Livuite, 1979	8,000	3	7	406	2,796,577	31.7
		● Malongo North, 1966	1,170- 9,250	53	61	14,533	220,826,849	30.0
		● Malongo South, 1966	1,150- 1,440	26	29	7,514	78,253,055	28.0
		● Malongo West, 1969	1,680- 8,800	25	35	19,895	244,753,554	22.5
		● Numbi, 1980	3,446	24	26	46,044	36,341,483	34.0
		● Takula, 1971	3,070- 9,090	66	72	103,661	235,651,419	31.5
		● Vuko, 1983	3,700	3	6	7,049	12,574,990	35.0
		● Wamba, 1982	2,700	7	7	29,023	30,144,650	29.0
	TEXACO-SONANGOL-TOTAL-BRASPETRO	● Cuntala, 1978	7,200	...	1	...	4,420,000	31.0
		● Essungo, 1975	6,500	8	10	3,575	39,795,000	35.0
		● Lombo Este, 1983	7,800	9	10	19,740	13,130,000	41.0
		● Sulele Oeste, 1985	7,600	6	6	2,986	2,630,000	41.0
		● Sulele South 1, 1986	7,600	1	3	1,712	1,085,000	39.0
		● Tubarão, 1984	7,600	6	7	11,164	7,800,000	41.0
	ELF ANGOLA$^{(e)}$	● Pacassa, 1982	11,500	39	39	125,677	145,391,043	38.0
		● Palanca, 1981	8,860					40.0
		Total Angola		**439**	**664**	**452,630**	**1,513,439,258**	
ARGENTINA	**YPF**$^{(e)}$	Chubut, 1907	1,908- 9,168	2,261	2,325	416,266	4,705,331,768	21.1-26.0
		Formosa, 1984	11,466-11,490	12	14			42.0-42.9
		Jujuy, 1969	2,461-16,732	9	9			46.5-47.0
		La Pampa, 1968	3,609- 4,921	198	209			31.0
		Mendoza, 1932	2,178-16,778	1,156	1,187			23.7-32.0
		Neuquen, 1918	1,312-12,498	1,160	1,205			24.0-41.0
		Rio Negro, 1960	2,953- 7,546	897	937			22.5-41.0
		Salta, 1928	6,551-15,092	33	43			29.0-59.0
		Santa Cruz, 1946	1,468-17,060	3,129	3,274			21.1-30.0
		Tierra del Fuego, 1959	5,249- 7,824	206	206			43.4-46.0
	AMOCO	Cerro Dragon, 1958	7,200	1,100	1,600	41,734	439,469,000	21.0
		Total Argentina		**10,161**	**11,009**	**458,000**	**5,144,800,768**	
AUSTRALIA	**BARRACK ENERGY**	Mount Horner, 1965	3,800- 5,800	7	12	360	219,165	38.0
	BHP PETROLEUM PTY. LTD	● Jabiru, 1983	4,786	4	4	40,800	36,144,789	42.3
		● Challis/Cassini, 1984	5,000	7	7	24,348	535,666	39.5
	HADSON ENERGY LTD.	● Harriet, 1983	6,230	10	10	11,200	14,253,000	38.2
	AGL PETROLEUM	Alton, 1964	6,000	4	8	29	1,909,000	49.5
		Anabranch, 1965	4,188	...	...	...	13,718	44.0
		Bennett, 1965	5,960	1	1	4	118,592	45.0
		Cabawin, 1961	10,800	1	1	3	62,337	49.0
		Maffra, 1965	4,251	1	1	14	38,162	48.0
		Mereenie, 1964	4,000	24	37	1,737	4,605,023	48.9
		Merrit, #1, 1985	4,521	1	1	47	50,154	51.0
		Moonie, 1961	5,800	20	38	560	22,103,380	44.5
		Richmond, 1963	3,643	...	...	...	16,345	43.0
		Snake Creek, 1964	4,990	...	...	...	13,158	67.0
		Sunny Bank, 1962	6,139	...	...	...	706	4[illegible].0
		Trinidad 1 & 3, 1965	4,599	...	...	...	63,560	4[illegible].0
	AMPOLEX (PPL) PTY. LTD.	Cranstoun, 1987	4,250	1	1	179	169,556	48.0
		Endeavour, 1989	5,085	1	1	202	9,494	49.7
		Ipundu, 1986	2,700	1	1	53	86,636	43.0
		Ipundu, North, 1989	4,354	1	1	25	1,055	49.7
		Monler, 1987	4,150	2	2	24	36,330	49.0
		Talgeberry, 1985	3,900	2	3	113	334,701	46.0
		Takyah, 1985	3,800	1	1	15	20,874	43.0
		Tarbat, 1988	2,700	1	1	7	13,648	43.0
		Tintaburra, 1984	3,500	5	6	271	643,194	43.0
		Toobunyah, 1985	3,500	4	5	241	403,172	43.0
	EROMANGA ENERGY	Blina, 1981	4,300	5	5	236	1,263,829	37.0
		Lloyd, 1987	4,806	1	1	87	113,836	37.0
		Sundown, 1983	3,600	2	2	25	189,868	39.0
		West Terrace, 1985	3,800	2	2	35	135,648	33.0

			No. of wells		Production		
	Name of field, discovery date	Depth, ft	Producing	Total	1989 average B/d	Cumulative to Dec. 31, 1989 Bbl	°API gravity
SANTOS LTD.	Alwyn, 1985	5,200	2	2	88	137,000	41.0
	Big Lake, 1984	6,600	2	3	133	419,000	45.0-48.0
	Bogala, 1984	6,900	2	2	210	381,000	40.0
	Bookabourdie, 1985	7,000	2	2	39	94,000	46.0
	Brolga, 1983	9,547	1	1	...	48,100	53.0
	Challum, 1983	...	...	1	...	21,000	...
	Chookoo, 1985	6,000	4	8	771	649,000	45.0
	Cook, 1985	...	...	1	...	29,000	...
	Corella, 1989	...	1	1	18	3,000	...
	Cooroo/Cooroo North, 1986	...	4	5	1,039	1,239,000	...
	Dingera, 1987	...	...	1	...	1,000	...
	Dirkala, 1986	7,000	1	1	108	572,000	56.0
	Dullingari, 1979	5,200	15	31	1,909	8,448,000	54.0
	Fly Lake, 1971	9,300	1	3	...	502,500	53.0
	Gidgealpa, 1984	6,150	13	13	2,276	3,770,000	45.0-50.0
	Gidgee, 1989	...	1	1	16	6,000	...
	Gunna, 1983	6,000	1	1	18	83,000	40.0
	James, 1989	...	1	1	12	4,000	...
	Jackson, 1981	4,750	35	36	9,030	27,774,000	40.0-48.0
	Jackson South, 1982	4,800	5	6	575	2,331,000	40.0
	Jena, 1985	5,200	4	4	220	162,000	41.0
	Kercummura, 1985	...	...	1	...	1,000	50.8
	Kerinna, 1984	4,300	...	1	3	18,000	41.0
	Limestone Creek/Biala, 1984	5,100	10	11	931	1,695,000	41.0
	Mawson, 1987	...	1	1	55	106,000	...
	McKinlay, 1985	5,100	1	2	6	33,000	41.0
	Meranji, 1985	5,660	3	3	142	433,000	1.0
	Merrimelia, 1983	5,250- 7,070	10	11	1,958	4,073,000	5.5
	Mooliampah, 1985	6,000	2	2	110	117,000	...
	Moorari, 1971	7,705- 9,400	6	6	...	1,598,000	6.9
	Munro, 1988	...	2	2	154	96,000	...
	Muteroo, 1985	6,000	5	5	1,479	2,507,000	5.0
	Naccowlah, 1989	...	1	1	25	9,000	...
	Naccowlah East, 1988	...	1	1	...	...	...
	Naccowlah South, 1983	6,000	9	10	831	2,608,000	0.0-46.0
	Naccowlah West, 1983	5,700	9	9	1,319	2,560,000	...
	Narcoonowie, 1983	6,000	2	2	106	193,000	2.0-53.0
	Natan	...	1	1	36	16,000	...
	Nungaroo, 1985	4,150	1	1	21	58,000	...
	Pinaroo, 1889	...	1	1	53	19,000	...
	Pintari North, 1988	...	1	1	35	33,000	...
	Pitchery, 1988	...	1	1	79	77,000	...
	Sigma, 1983	5,700	2	2	140	164,000	...
	Spencer, 1986	6,500	6	6	1,393	1,588,000	7.0
	Strzelecki, 1978	5,800	15	17	2,902	13,719,000	3.0-49.0
	Sturt, 1988	...	4	4	515	217,000	...
	Sturt East	...	4	4	1,862	687,000	...
	Taloola, 1988	...	2	2	535	317,000	...
	Tantanna, 1988	...	4	4	3,719	1,672,000	...
	Tickalara, 1984	5,600	5	5	1,123	830,000	...
	Tinpilla, 1983	6,000	1	1	22	87,000	...
	Tirrawarra, 1970	9,500	29	40	...	11,564,300	2.0
	Toby, 1987	...	...	1	...	25,000	...
	Ulandi, 1985	5,200	3	3	154	153,000	0.4
	Wandilo, 1989	...	2	2	106	39,000	...
	Wancoocha, 1984	6,000	3	6	344	1,400,000	4.0-54.0
	Watson, 1985	...	2	2	231	251,000	...
	Watson South, 1985	5,500	2	2	643	1,006,000	40.0
	Wilson, 1983	5,000	5	6	289	508,000	...
	Woolkina, 1982	9,700	1	2	...	101,900	1.5
	Yanda, 1984	8,000	1	1	18	63,000	...
WAPET GROUP	Barrow Island, 1964	1,200- 6,700	412	539	15,232	236,544,108	37.7
	Dongara, 1969	5,250- 5,577	1	9	31	977,414	35.5
	Thevenard Island, 1985	4,600- 5,750	7	7	25,848	1,163,165	48.2
WOODSIDE	● North Rankin,[c] 1972	9,800	13	18	23,200	25,950,000	52.3
COMMAND	Dilkera, 1989	3,447	1	2	15	1,781	46.0
	Fairymount, 1985	6,730	5	6	485	446,044	50.5
	Kihee, 1986	3,200	...	2	...	813	44.7
	Koora, 1985	4,822	...	1	...	952	41.0
	Maxwell, 1987	2,930	3	3	204	187,826	47.2
	Mindagabie, 1987	5,290	...	1	...	658	10.3
	Muthero, 1989	3,448	2	2	81	8,184	44.4
	Nockatunga, 1983	3,310	3	5	120	338,187	48.0
	Thungo, 1986	3,345	4	4	218	290,935	46.8
	Winna, 1985	3,300	2	2	60	126,034	15.8
ESSO-BHP	● Barracouta, 1965	4,550	7	10	2,260	35,083,000	62.8
	● Bream, 1969	6,200	15	16	19,770	9,240,000	44.0
	● Cobia, 1972	7,700	9	13	26,420	86,058,000	44.6
	● Flounder, 1968	8,200	18	22	20,040	26,764,000	46.7
	● Fortescue, 1978	7,700	17	29	56,050	191,325,000	43.0
	● Halibut, 1967	7,700	11	19	38,930	722,308,000	43.3

PRODUCTION

WORLDWIDE PRODUCTION

				No. of wells		Production		
		Name of field, discovery date	Depth, ft	Producing	Total	1989 average B/d	Cumulative to Dec. 31, 1989 Bbl	°API gravity
		• Kingfish, 1967	7,500	20	35	39,720	966,306,000	46.9
		• Mackerel, 1969	7,700	14	18	42,690	389,364,000	45.6
		• Marlin, 1966	5,100	19	24	10,940	62,201,000	50.0
		• Snapper, 1968	4,350	11	27	6,480	16,272,000	47.0
		• Tuna, 1968	6,500	12	18	7,060	37,754,000	40.5
		• West Kingfish, 1968	7,500	14	19	35,540	83,883,000	46.9
		• Whiting, 1983	4,800	4	5	1,630	596,000	53.0
	MARATHON AUST	• Talisman, 1984	9,600	1	1	7,334	3,473,446	41.0
	OIL COMPANY OF AUSTRALIA	Riverslea, 1981	4,950	2	2	69	358,031	37.0
		Bora Creek, 1982	4,900	1	1	6	17,318	34.0
		Kincora, 1980	4,700	1	1	...	304,131	34.0
		Sandy Creek, 1982	4,900	...	...	...	8,730	34.0
		Waratah, 1982	5,350	3	4	42	299,315	34.0
		Washpool, 1985	5,250	1	1	2	2,145	35.0
	LASMO(e)	Black Stump, 1986	5,360	1	1			
		Bodalla South, 1984	4,800- 5,230	6	6			
		Glenvale, 1985	3,800	...	1			
		Kenmore, 1985	4,600- 4,980	10	11			
	BRIDGE OIL LTD.(e)	Boggo Creek, 1980	5,320	...	1			46.0
		Louise, 1986	5,910	1	2			58.0
		Narrows, 1986	5,739	1	1	4,000	9,850,000	60.0
		Taylor, 1988	5,538	5	5			47.0
		Thornby Creek, 1979	5,170	...	4			50.0
		Waggamra, 1978	7,670	1	1			55.0
		Yellow Bank Creek, 1982	5,180	2	2			52.0
	STRATA OIL(e)	Woodada,(c) 1980	7,400	...	...			54.0
	WESTERN MINING CORP.(e)	• North Herald, 1982	3,937	1	1			44.0
		• South Pepper, 1982	4,036	1				44.0
		Total Australia		**1,024**	**1,363**	**502,883**	**3,088,069,026**	
AUSTRIA	MOBIL/SHELL	Gaiselberg, 1938	5,200	32	65	709	32,651,157	27.0
		Kemating, 1979	6,100	8	9	705	4,248,509	34.0
		Sattledt, 1971	5,700	11	20	607	5,449,472	37.0
		Other	...	62	158	1,518	46,927,432	33.0
	OEMV(e)	Hochleiten, 1977	3,100- 5,000					21.3
		Matzen, 1949	6,100					25.7
		Pirawarth, 1957	1,600- 6,500	957	1,255	18,399	590,199,421	28.4
		St. Ulrich, 1938	1,600- 4,300					31.1
		Total Austria		**1,070**	**1,507**	**21,938**	**679,475,991**	
BAHRAIN	BANOCO	Awali, 1932	1,850- 4,600	286	358	39,034	813,600,000	33.0
		Total Bahrain		**286**	**358**	**39,034**	**813,600,000**	
BARBADOS	BARB. NOC	Woodbourne, 1966	1,732- 6,701	88	142	1,066	5,406,678	27.2
		Total Barbados		**88**	**142**	**1,066**	**5,406,678**	
BENIN(e)	WILLIAMS BROTHERS ENGINEERING	• Seme, 1968	6,232	6	6	4,000	14,814,000	...
		Total Benin		**6**	**6**	**4,000**	**14,814,000**	
BOLIVIA	YPFB	Camiri, 1927	3,936	43	54	362	48,587,297	55.0
		Carand, 1960	3,940	33	43	299	54,359,920	60.0
		Cascabel, 1985	11,319	1	1	261	229,361	45.6
		Colpa, 1961	9,184	11	15	154	18,284,329	65.0
		Espino, 1979	14,655	...	3	...	966,307	56.2
		H. Suarez R., 1982	7,820	...	3	...	486,650	35.0
		La Pena, 1965	8,856	26	31	4,966	28,619,039	43.0
		Monteagudo, 1966	4,592	20	25	1,326	32,581,324	41.0
		Naranjillos, 1964	4,806	12	14	128	92,754	65.3
		Palmar, 1964	10,758	3	5	82	1,746,131	65.0
		Rio Grande, 1961	9,512	35	43	1,905	61,459,486	62.0
		San Roque, 1981	7,170	8	8	1,739	1,350,869	71.0
		Santa Cruz, 1986	9,350	8	9	540	1,739,272	65.0
		Siran, 1985	13,999	3	3	707	313,732	65.3
		Tita, 1976	6,450	7	7	82	4,408,595	..
		Vibora, 1988	12,949	3	3	632	328,384	57.7
		Villamontes, 1987	9,770	2	3	354	554,980	57.0
		Vuelta Grande, 1978	8,220	16	18	2,448	3,273,748	67.0
		Other	...	50	73	619	31,214,320	...
	OCCIDENTAL	Porvenir, 1978	9,600	5	9	2,011	11,967,963	60.5
	TESORO BOLIVIA PETROLEUM CO.	Escondido, 1980	11,293	3	6	5	1,862	60.0
		Los Suris, 1981	13,577	...	1	...	...	50.0
		La Vertiente, 1977	15,230	6	7	1,118	4,804,834	64.1
		Taiguati, 1981	10,174	1	2	193	70,409	63.0
		Total Bolivia		**296**	**386**	**19,931**	**307,441,476**	

BRAZIL

	Name of field, discovery date	Depth, ft	No. of wells		Production		
			Producing	Total	1989 average B/d	Cumulative to Dec. 31, 1989 Bbl	°API gravity
ALAGOAS	Furado, 1969	4,440- 5,500	51	68	2,030	15,400,380	35.0
	● Mero, 1974	6,500- 7,400	...	...	...	151,000	35.0
	Pilar, 1981	4,100- 5,100	56	62	5,580	14,089,900	40.0
	Tabuleiro de Martins, 1957	3,900- 4,950	28	29	430	4,154,450	27.0
	Other	...	18	27	560	2,169,520	...
AMAZONAS	Igarape Cuia, 1985	3,600- 3,700	...	...	...	25,250	41.0
	Rio Urucú, 1986	7,500- 8,300	13	13	3,200	1,254,000	44.0
BAHIA	Agua Grande, 1951	820- 4,265	113	124	4,830	276,968,000	40.0
	Aracas, 1965	3,280- 8,856	149	181	6,370	113,834,390	41.0
	Buracica, 1959	1,476- 1,840	171	190	5,600	139,922,730	35.0
	Candeias, 1941	3,280- 7,415	36	39	2,500	79,250,420	30.0
	● Candeias Mar, 1941	3,300- 7,400	17	17	520	7,276,920	30.0
	Cassarongongo, 1959	1,475- 4,755	153	159	3,410	16,757,050	32.0
	Cexis, 1983	1,670- 5,230	34	34	2,690	4,771,900	30.0
	● Dom Joao Mar, 1947	920- 3,000	219	289	3,450	83,792,880	38.0
	Dom Joao Terra, 1947	920- 1,350	57	94	890	21,002,610	38.0
	Faz. Alvorada, 1983	2,100- 4,900	80	80	4,850	8,403,730	31.0
	Faz. Balsamo, 1983	2,500- 4,000	114	118	6,600	11,342,630	31.0
	Faz. Boa Esperanca, 1966	7,215- 8,036	21	23	1,100	15,900,040	39.0
	Faz. Imbe, 1964	2,130- 5,575	59	78	1,800	16,044,860	40.0
	Faz. Panelas, 1962	2,400- 5,100	14	27	400	6,695,900	37.0
	● Ilheus, 1979	1,500	...	...	...	895,470	41.0
	Malombe, 1966	3,280	9	15	300	7,078,300	41.0
	Mata/Remanso, 1971	4,445- 4,560	63	76	1,830	20,897,720	35.0
	Miranga, 1965	3,280- 3,936	227	322	8,570	185,196,800	40.0
	Riacho da Barra, 1982	2,910- 3,998	51	63	2,900	12,691,340	39.0
	Rio Dos Ovos, 1979	2,410- 3,750	10	10	310	2,134,110	35.0
	Rio Pojuca, 1982	5,600- 6,200	29	42	2,200	5,340,500	35.0
	Rio do Bú, 1984	2,900- 3,000	50	50	3,950	4,219,650	33.0
	Santana, 1962	2,400- 4,000	5	6	100	5,640,870	37.0
	Sesmaria, 1963	3,100- 4,600	26	26	640	3,332,070	40.0
	Taquipe, 1958	3,115- 3,935	109	138	3,750	87,104,890	40.0
	Other	...	150	239	6,040	32,273,600	...
CEARÁ	● Atum, 1983	5,800- 6,750	20	22	5,420	9,926,100	25.0
	● Curima, 1978	6,888	15	17	3,230	19,976,850	32.0
	● Espada, 1983	5,750- 6,900	6	6	1,390	4,473,300	26.0
	Faz. Belem, 1980	1,150- 2,500	281	567	400	6,909,300	13.0
	● Xareu, 1977	5,717- 5,766	25	27	2,700	15,501,100	39.0
ESPIRITO SANTO	● Cacao, 1978	9,184	7	12	3,450	10,993,870	32.0
	Faz. Cedro, 1962	5,248	11	14	560	10,203,790	28.0
	Lagoa Parda, 1977	5,576	49	50	3,440	23,071,160	30.0
	Lagoa Piabanha, 1984	6,500	2	2	100	1,691,290	27.0
	Lagoa Suruaca, 1982	6,400	22	26	1,650	5,722,440	30.0
	Rio Itaunas, 1977	5,400	40	40	960	4,010,260	28.0
	Rio Preto/Oeste/Sul, 1976	...	37	37	730	2,361,870	...
	Sao Mateus, 1969	5,750	45	53	1,060	4,920,730	27.0
	Other	...	125	125	4,880	8,250,830	...
RIO DE JANEIRO	● Albacora, 1984	8,430	7	12	16,930	12,985,230	26.0
	● Anequim, 1981	8,200- 8,500	2	2	2,620	4,807,580	27.0
	● Area RJS-150, 1983	7,300	...	...	...	296,070	26.0
	● Area RJS-236 Trilha, 1983	8,800-11,000	3	3	3,370	11,577,950	28.0
	● Area RJS-387, 1987	11,300	3	3	2,030	2,818,080	34.0
	● Badejo, 1981	8,500-10,500	5	6	3,390	18,675,900	28.0
	● Bagre, 1983	8,700- 9,000	7	9	4,370	8,175,800	25.0
	● Bicudo, 1982	8,000-11,000	11	13	17,970	42,172,120	22.0
	● Bonito, 1977	6,950- 8,000	11	17	12,590	36,420,970	27.0
	● Carapeba, 1982	10,100	29	36	16,570	6,062,050	23.0
	● Cherne, 1982	9,900-10,200	29	41	37,490	66,063,850	27.0
	● Corvina, 1983	9,000-11,000	5	8	15,040	36,197,360	25.0
	● Enchova, 1976	6,973- 7,885	4	24	5,400	79,311,850	23.0
	● Garoupa, 1974	11,382	19	20	21,290	77,847,590	30.0
	● Garoupinha, 1974	12,693	3	3	2,960	12,880,240	30.0
	● Linguado, 1981	9,000-11,000	11	18	25,760	73,211,580	20.0
	● Marimba, 1983	8,900- 9,200	5	5	19,530	19,986,100	28.0
	● Moreia, 1984	8,200- 9,500	5	6	3,400	4,616,400	22.0
	● Namorado, 1975	10,083	27	45	55,320	140,641,710	28.0
	● Pampo, 1977	6,215	24	31	36,200	122,714,750	21.0
	● Parati, 1982	8,900- 9,200	1	1	1,120	5,566,630	35.0
	● Pargo, 1975	11,840	16	21	12,350	4,509,410	20.0
	● Pirauna, 1982	8,000-10,500	7	8	15,740	32,516,320	27.0
	● Sul de Pampo, 1978	9,300- 9,600	...	...	...	...	20.0
	● Vermelho, 1983	11,200	45	62	12,550	4,579,600	24.0
	● Viola, 1981	9,200- 9,900	8	8	7,310	13,898,640	13.0
RIO GRANDE DO NORTE	● Agulha, 1975	5,412	5	6	1,000	7,761,100	33.0
	Alto do Rodrigues, 1981	990- 1,120	290	292	3,570	8,518,410	18.0
	● Area 1-RNS-36, 1982	...	...	...	...	178,290	32.0
	Canto do Amaro, 1986	2,500- 3,600	470	486	34,200	22,143,060	25.0
	Estreito Rio Panon, 1983	650- 820	447	447	5,400	12,190,780	16.0
	Faz. Focinho, 1982	1,450- 2,000	174	174	4,420	11,818,520	35.0
	Guamare, 1983	1,400- 1,600	30	33	560	1,844,960	25.0

		Name of field, discovery date	Depth, ft	No. of wells Producing	No. of wells Total	Production 1989 average B/d	Production Cumulative to Dec. 31, 1989 Bbl	°API gravity
		Livramento, 1986	2,500- 3,300	30	30	2,900	4,856,670	41.0
		Lorena, 1984	1,200- 1,700	12	12	240	836,420	28.0
		● Macau-Mar, 1986	3,000	5	5	170	508,370	31.0
		Macau/Terra, 1982	3,000- 3,300	2	2	50	449,040	34.0
		Palmeiras, 1982	1,450- 1,800	...	...	...	...	25.0
		Serraria, 1982	3,200- 3,900	38	38	1,320	3,374,340	27.0
		● Ubarana, 1973	7,216- 8,365	77	92	14,650	58,134,730	40.0
		Upanema, 1985	1,110- 1,800	15	18	850	2,239,380	28.0
		Other	...	118	119	4,850	4,220,020	...
	PARÁ	● Area 1-PAS-11, 1983	...	...	...	...	421,300	41.0
	MARANHÃO	São João, 1983	4,950- 6,200	...	...	...	75,000	40.0
	SERGIPE	Atalaia Sul, 1961	1,450	2	3	7	2,688,650	24.0
		Brejo Grande, 1967	1,670	12	12	300	2,009,740	26.0
		● Caioba, 1969	6,232- 6,890	10	14	1,770	30,996,420	36.0
		● Camurim, 1970	6,232	61	62	6,490	19,754,830	25.0
		Carmopolis, 1963	2,460	852	1,008	25,970	179,890,490	24.0
		● Dourado, 1970	3,620- 3,635	4	4	270	4,546,540	36.0
		● Guaricema, 1968	3,335- 4,430	13	16	4,040	37,959,950	41.0
		Riachuelo, 1961	1,475	235	318	3,400	23,090,630	28.0
		● Robalo, 1973	3,300- 4,500	...	...	...	828,000	30.0
		Siririzinho, 1967	1,640	177	260	4,730	38,023,300	30.0
		Other	...	84	85	1,420	4,735,450	...
		Total Brazil		**6,267**	**7,574**	**591,697**	**2,656,654,940**	
BRUNEI	**SHELL**	○ Ampa SW, 1963	7,068- 8,155	116	222	41,640	543,800,000	41.0
		● Champion, 1970	4,300	113	213	41,067	315,100,000	23.0
		● Fairley, 1969	10,740	37	54	13,907	115,300,000	40.0
		● Magpie, 1975	...	17	23	16,033	79,300,000	31.0
		Rasau, 1929	...	4	13	786	5,300,000	30.0
		Seria-Total, 1929	...	269	569	18,977	988,200,000	34.0
		Total Brunei		**556**	**1,094**	**132,410**	**2,047,000**	
CAMEROON(e)	**ELF**	● Betika, 1972	5,300	175	179	169,000	501,504,900	42.5
		● Ekoundou S., 1975	6,200					24.0
		● Kole, 1974	5,500					31.0
		● Kombo Center, 1976	5,900					37.0
		● Kombo North, 1978	7,200					35.0
		● Ekoundou Horst plus Center, 1972	7,200					29.0
		● Boa, 1976	5,900					35.0
		● Bavo South, 1976	5,600					29.3
		● Betika S. Marine, 1979	6,300					30.0
		● Ekuondou N. Marine, 1977	5,250					36.0
		● Mokoko NE plus Abana, 1977	4,600					29.0
		● Asoma Marine, 1973	3,600					19.0
		● Kita E. Marine, 1978	6,900					40.8
		● Mokoko S. Marine, 1977	3,300					17.0
		● Inova Marine, 1976	6,200					32.8
	TOTAL-CFP	● Moudi, 1979	5,250- 5,900					40.0
		● Moudi D., 1980	3,300					21.3
		Total Cameroon		**175**	**179**	**169,000**	**501,504,900**	
CANADA	**ALBERTA**	Acheson, 1950	3,390	57	118	13,180	132,037,229	38.0
		Bantry, 1940	2,574- 3,300	171	210	9,270	52,741,483	...
		Bellshill Lake, 1955	2,950	425	458	11,640	67,493,984	...
		Bonnie Glen, 1952	3,959- 6,779	134	169	12,445	507,143,641	34.0-44.0
		Caroline	...	187	282	7,800	68,884,903	...
		Carson Creek N., 1958	8,787- 8,935	36	64	7,935	143,308,313	44.0
		Clive, 1951	6,074- 6,208	117	186	4,771	52,946,209	...
		Cessford, 1950	2,800- 3,028	173	301	2,867	32,012,372	...
		Countess, 1951	2,858- 4,272	134	173	6,019	66,053,533	...
		Fenn-Big Valley, 1950	3,900- 5,400	118	295	5,323	317,705,752	32.0
		Gilby, 1962	4,201- 7,000	71	162	2,899	48,510,868	...
		Golden Spike, 1949	3,570- 5,961	69	84	2,025	182,483,299	36.0
		Grand Forks	...	363	453	21,745	98,317,645	...
		Harmattan East, 1954	6,358- 8,766	106	147	4,409	74,137,864	...
		Harmattan Elkton, 1955	8,796-10,757	63	82	3,919	63,493,732	...
		Hayter, 1968	2,030- 2,815	258	418	7,236	15,372,066	...
		Innisfail, 1956	6,730- 8,440	27	70	4,073	76,682,493	...
		Joarcam, 1949	3,179	173	272	6,097	104,473,973	...
		Joffre, 1953	4,983- 6,779	83	187	3,784	84,639,872	...
		Judy Creek, 1951	8,307- 8,701	183	268	19,349	402,547,694	43.0
		Kaybob, 1957	4,870- 9,577	68	94	5,869	104,674,986	...
		Kaybob S., 1958	5,600-10,042	72	100	7,736	82,373,557	...
		Leduc-Woodbend, 1947	3,062- 5,380	236	708	3,586	378,143,547	40.0
		Lloydminster, 1933	1,690- 1,945	413	964	5,066	51,224,674	...
		Medicine River, 1954	5,435- 7,600	259	364	10,175	75,086,351	...
		Mitsue, 1964	5,908	293	411	31,881	293,845,831	43.0
		Nipisi, 1965	5,648- 5,726	270	359	29,124	285,619,187	41.0

				No. of wells		Production		
		Name of field, discovery date	Depth, ft	Producing	Total	1989 average B/d	Cumulative to Dec. 31, 1989 Bbl	°API gravity
		Pembina, 1953	3,000- 6,133	3,340	4,245	98,870	1,277,689,925	32.0-37.0
		Provost, 1946	2,760- 2,898	1,561	2,104	40,139	94,882,223	...
		Rainbow, 1965	4,994- 6,160	268	367	41,715	529,321,452	38.0-42.0
		Rainbow South, 1965	6,102- 6,400	47	80	5,954	66,441,552	...
		Red Earth, 1956	4,184- 4,878	186	280	4,838	39,730,041	...
		Redwater, 1948	2,012- 3,200	588	884	12,957	794,082,745	35.0
		Simonette, 1958	10,500	28	51	2,114	38,982,776	...
		Snipe Lake, 1962	8,500	39	97	3,392	55,287,679	...
		Sturgeon Lake S., 1953	4,912- 8,471	89	149	13,976	147,941,250	...
		Swan Hills, 1957	8,100	566	837	37,683	695,276,591	40.0
		Swan Hills S., 1959	8,400	169	200	14,100	349,577,767	...
		Taber N., 1966	3,110- 3,270	78	106	5,845	16,973,413	...
		Turner Valley, 1913	3,100- 9,150	111	158	2,612	140,871,493	39.0
		Utikuma Lake, 1963	5,624	109	139	11,742	52,240,255	...
		Valhalla, 1973	1,815- 7,060	258	303	8,056	13,720,829	...
		Virginia Hills, 1957	9,210	127	188	15,927	153,776,591	34.0
		Wainwright, 1925	1,903- 2,200	565	756	8,947	72,358,599	...
		Westerose, 1952	6,818	34	42	10,009	134,043,358	...
		Westpem	...	11	14	13,356	30,693,959	...
		Willisden Green, 1956	5,157	563	823	8,026	120,111,497	...
		Wizard Lake, 1951	4,044- 5,973	42	47	9,142	325,853,244	...
		Zama, 1966	3,702	120	243	6,719	78,026,436	33.0-37.0
		Other	...	8,362	13,061	312,623	1,594,878,246	...
	BRITISH COLUMBIA	Boundary Lake, 1957	3,418- 4,575	279	358	9,775	175,250,142	40.0
		Eagle West, 1976	2,170- 3,940	51	96	6,224	29,198,918	...
		Other	...	375	813	18,103	240,343,836	...
	MANITOBA	All fields	...	1,353	1,581	12,462	170,671,122	...
	SASKATCHEWAN	Steelman, 1950	646	731	8,499	258,451,734	...	
		Weyburn, 1955	4,600	821	895	16,692	293,279,794	...
		Other	...	12,199	16,939	175,397	1,778,953,854	...
	ONTARIO	All fields	...	1,091	1,588	4,202	63,782,474	...
	NEW BRUNSWICK	All fields	...	...	...	...	805,261	...
	NORTHWEST TERRITORIES	All fields	...	159	164	32,344	77,377,132	...
		Total Canada*		**38,794**	**55,738**	**1,222,673**	**13,772,831,606**	
CHILE	**ENAP-MAINLAND**	Canadon, 1962	6,090	11	62	189	14,622,376	38.4
		Daniel, 1960	5,806	10	121	195	34,553,574	25.4
		Daniel Este, 1961	5,523	9	66	227	28,500,354	25.0
		Delgada Este, 1958	7,694	9	31	195	4,935,059	35.0
		Dungeness, 1962	5,251	4	19	198	4,080,927	28.6
		Faro Este, 1959	7,381	7	32	192	3,362,757	35.0
		Posesion, 1960	5,622	31	76	675	21,685,069	63.6
		Other	...	9	118	1,964	15,605,639	...
	TIERRA DEL FUEGO	Calafate, 1955	6,045	17	61	839	26,121,984	49.3
		Catalina, 1956	5,756	9	26	351	6,615,322	38.7
		Catalina Sur, 1961	5,779	4	43	45	6,385,022	44.0
		Chañarcillo, 1951	7,404	2	17	44	7,241,717	58.2
		Cullen, 1954	5,730	17	106	341	41,233,096	41.8
		Gorrión, 1986	6,025	6	10	756	1,017,551	39.0
		San Sebastián Norte, 1986	6,870	4	4	85	168,471	37.0
		Sombrero, 1951	7,126	1	23	3	13,108,843	40.2
		Tres Lagos, 1957	5,724	22	84	507	16,148,103	40.1
		Victoria Sur, 1950	7,431	4	34	52	7,876,783	41.1
		Other	...	46	255	1,272	30,664,301	...
	STRAIT OF MAGELLAN	Daniel Este-Dungeness, 1977	6,126	14	36	1,423	4,685,424	35.9
		Jaiba, 1978	6,650	3	3	188	314,213	46.5
		Ostion, 1977	7,156	13	18	644	8,314,321	33.0
		Pejerrey, 1984	7,229	20	75	1,384	9,959,809	39.0
		Posesion, 1977	6,727	17	39	493	5,555,950	34.5
		Skúa, 1988	5,932	34	39	4,903	2,965,391	32.0
		Spiteful, 1977	6,298	34	82	2,993	43,534,087	34.5
		Spiteful Norte, 1978	7,150	9	55	455	9,661,180	39.0
		Total Chile		**366**	**1,535**	**20,613**	**368,917,323**	
CHINA(e)	**WESTERN REGION: JUNGGAR BASIN, TARIM BASIN, TURPEN BASIN**	Karamay, 1955	...					...
		Dushanzi, 1941	...					...
		Other	...					...
	CENTRAL REGION: JIUQUAN BASIN	Yumen, 1938	...					...
	CENTRAL REGION: SICHUAN BASIN	All fields	...					...
	CENTRAL REGION: SHAN-GAN-NING BASIN	Chang Qing, 1978	...					
		Yanchang, 1907	...					
	CENTRAL REGION: QAIDAM BASIN	Qinghai, 1955	...					
		Lenghu 3,4,5, 1958	...					
		Other	...					

*Does not include oil sands production nor wells.

WORLDWIDE PRODUCTION

		Name of field, discovery date	Depth, ft	No. of wells		Production		°API gravity
				Producing	Total	1989 average B/d	Cumulative to Dec. 31, 1989 Bbl	
	EASTERN REGION: SONGLIAO BASIN	Daqing, 1959	...	43,700	NA	2,747,507	14,699,906,000	...
		Fuyn, 1958	...					...
		Jilin, 1978	...					...
	EASTERN REGION: BOHAI BASIN	Shengli, 1962	...					...
		Renqiu, 1975	...					...
		Liaohe, 1964	...					...
		Dagang, 1964	...					...
		Zhongyuan, 1981	...					...
		Itu, 1970	...					...
	EASTERN REGION: JIANGHAN BASIN	Qianjiang, 1966	...					...
		Other	...					...
	EASTERN REGION: NANXIANG BASIN	Nanyang, 1971	...					...
	EASTERN REGION: SUBEI BASIN	All fields	...					...
		Total China		**43,700**	**NA**	**2,747,507**	**14,699,906,000**	
CHINA, TAIWAN	CHINESE PETROLEUM	• CBK, 1986	...	5	9	767		47.0
		Chingtsohu, 1967	...	5	17	82		50.0
		Chuhuangkeng, 1960	...	30	30	232	23,565,169	50.0
		Tiechengshan, 1959	...	23	31	331		51.0
		Yunghoshan, 1971	...	25	33	314		45.0
		Total China, Taiwan		**88**	**120**	**2,326**	**23,565,169**	
COLOMBIA	ARGOSY$^{(e)}$	Bourdine, 1974	11,000	2	4			26.7
		Máxime, 1976	11,000	1	1			11.0
		Nancy, 1974	11,000	1	1			26.0
	HOCOL SA (SHELL)$^{(e)}$	Palogrande, 1971	6,500	32	36			20.0
		Pijao, 1981	7,000	6	7			21.0
		San Francisco, 1985	2,800	41	41			27.0
		Hato Nuevo, 1984	6,900	2	4			36.0
		Tenay, 1985	11,500	3	3	54,888	302,478,624	36.3
		Santa Clara, 1987	2,100	5	6			19.0
		La Jagua, 1986	5,300	2	2			22.0
		Loma Larga, 1985	3,500	1	1			22.4
		Brisas, 1973	4,200	4	6			23.5
		Dina T, 1962	3,600	51	64			20.0
		Dina K, 1969	6,500	22	26			22.0
		La Canada, 1966	700	5	7			22.0
		Tello, 1972	7,500	30	34			22.0
		Cebu, 1981	6,500	8	10			19.0
	ECOPETROL	Apiay, 1981	10,600	13	15	12,370	20,350,000	23.0
		Apiay Este, 1987	10,300	1	1	190	150,000	16.0
		Boquete, 1962	8,100	8	24	330	17,500,000	43.0
		Caipal/Ermitaño, 1954, 1957	3,500	3	19	60	4,280,000	15.0
		Campo Yuca, 1958	...	1	4	10	450,000	32.0
		Cantagallo/Yarigui, 1943, 1955	6,800-8,700	68	92	7,300	135,040,000	20.0
		Carbonera, 1939	...	4	8	40	490,000	32.0
		Caribe, 1970	5,400	3	4	320	3,860,000	31.0
		Casabe, 1940	3,800	909	1,039	9,700	231,750,000	19.0-22.0
		Churuyaco/Sucombios, 1967, 1969	...	6	7	510	4,750,000	31.0
		Cicuco, 1948	8,600	5	28	300	43,610,000	41.0
		Colorado, 1925	...	45	76	80	8,190,000	34.0
		Galan/San Silvestre, 1943	3,200	53	102	820	23,310,000	18.0
		Garzas, 1957	...	1	2	110	570,000	28.0
		Guatiquia, 1985	10,700	2	2	620	360,000	20.0
		Hormiga, 1982	10,300	2	3	160	710,000	29.0
		Infantas, 1918	3,200	305	568	1,750	226,070,000	28.0
		La Cira, 1918	3,250	707	951	7,610	468,670,000	23.0
		La Cristalina, 1950	10,000	1	8	200	5,690,000	30.0
		Llanito/Gala/Yuma/Cardales, 1955, 1985, 1988, 1988	9,500	145	219	6,480	41,970,000	28.0-32.0
		Lisama/Nutria/Tesoro Petroles, 1936, 1966, 1977	9,500	145	219	6,480	41,970,000	28.0-32.0
		Loro, 19067	10,300	7	12	710	11,570,000	30.0
		Orito, 1948	600- 5,200	51	104	8,790	196,310,000	25.0-35.0
		Ortega, 1951	6,500	5	15	380	11,750,000	28.0
		Palagua, 1954	3,500	96	186	3,840	83,330,000	15.0
		Peñas Blancas, 1957	...	6	7	380	8,910,000	23.0
		Petrolea, 1933	1,200	5	34	150	36,970,000	46.0
		Puerto Barco, 1958	...	...	4	20	600,000	50.0-60.0
		Puerto Colon, 1967	9,600	7	10	4,030	13,730,000	29.0
		Quilili, 1988	...	2	3	610	250,000	21.0
		Rio de Oro, 1933	1,600-8,500	20	54	60	10,670,000	32.0-43.0
		San Antonio (S. Miguel), 1967	7,820	2	4	80	4,740,000	28.0
		Sardinata Norte/Sur, 1939, 1942	900- 4,100	14	39	260	8,480,000	30.0-52.0
		Sucio, 1971	5,500	1	2	70	1,480,000	31.0
		Suria, 1985	10,500	7	8	2,290	850,000	35.0
		Tibu, 1939	4,500- 9,300	250	508	4,980	230,310,000	32.0-45.0
		Toldado, 1987	6,200	6	7	2,680	1,050,000	20.0

WORLDWIDE PRODUCTION

				No. of wells		Production		
		Name of field, discovery date	Depth, ft	Producing	Total	1989 average B/d	Cumulative to Dec. 31, 1989 Bbl	°API gravity
		Other	...	7	71	...	990,000	...
		Aguas Blancas, 1962	...	4	7	3,100	650,000	20.0
		Barrancas Lebrija, 1953	8,000	2	11		140,000	25.0
		Pavas, 1981	...	1	1		40,000	21.0
		San Luis, Totomal, 1927, 1950	...	2	7		1,200,000	24.0-35.0
		Sogamoso, 1958	...	2	4		850,000	29.0
		Tenerife, 1967	...	1	3		390,000	18.0
	ESSO COLOMBIANA LTD.	Arauca, 1980	18,000	3	4	1,775	5,913,510	40.0
		Bonanza, 1963	4,000	17	17	646	13,246,795	27.0
		Provincia, 1962	8,000	152	172	14,926	166,964,261	30.0
		Sabana, 1989	14,000	3	3	186	103,697	25.0
	ELF AQUITAINE	Barquerena, 1982	9,300	3	3	1,408	3,327,205	33.5
		Cano Garza, 1979	7,900	4	4	2,281	2,123,708	33.0
		Cano Garza Norte, 1983	7,900	2	2	915	2,009,235	38.5
		Cravo Este, 1987	11,376	...	1	289	108,833	40.1
		Cravo Sur, 1982	10,600	2	2	1,865	2,925,853	39.0
		Gloria Norte, 1983	12,100	2	2	2,031	1,605,104	18.0
		Morichal, 1984	15,500	1	1	273	99,542	30.0
		Tierra Blanca, 1987	14,493	1	1	358	130,506	32.0
		Tocaria, 1980	13,500	2	3	720	1,179,647	32.2
		Trinidad, 1974	9,000	4	4	3,788	5,090,719	33.0
	OCCIDENTAL	Caño Limón, 1984	7,600	47	54	172,219	230,057,128	29.0
		Cano Yarumal, 1987	7,600	2	2	12,256	4,630,143	29.0
		La Salina, 1936	2,500	38	71	3,105	14,494,004	28.0
		Payoa, 1962	8,000	24	39	953	70,022,300	27.0
		Redondo, 1984	7,600	3	4	5,678	5,998,120	30.2
	TEXACO	Cocorna, 1963	2,100	46	54	1,726	14,539,000	12.0-13.0
		Tisquirama, 1963	8,000	5	6	422	4,977,000	16.0-28.0
		Velasquez, 1946	7,500	92	100	3,123	166,961,000	19.0-24.0
	TEXACO-ECOPETROL	Los Angeles, 1983	6,400	4	6	669	784,000	14.0-15.0
		Nare, 1981	2,100	49	49	1,792	974,000	11.0-12.0
		Teca, 1981	2,100	187	200	14,241	29,976,000	12.0-13.0
	CHEVRON	Castilla, 1969	6,500	17	19	12,528	29,430,090	13.5
		Chichimene, 1969	6,500	1	2	466	770,488	21.3
	LASMO	Santiago, 1985	9,600	4	4	2,343	2,093,945	29.0
		Total Colombia		**3,771**	**5,442**	**404,000**	**2,971,904,457**	
CONGO	**AGIP**	• Loango, 1972	3,000	52	62	7,823	87,479,524	6.8
		Zatchi	1,980	8	8	3,296	1,486,665	5.9
	ELF CONGO	Bindi, 1982	4,400	1	1	40	143,000	34.2
		• Emeraude, 1969	820	92	99	20,300	175,400,000	22.3
		Kunji, 1980	4,000	2	2	130	586,000	35.8
		• Likouala, 1972	4,270	27	44	15,300	62,800,000	32.3
		Mengo, 1979	6,500	3	3	150	742,000	34.0
		Pointe Indienne, 1951	5,000	3	5	130	7,108,000	36.9
		• Sendji, 1973	3,940	50	76	29,100	65,600,000	29.5
		• Tchibouela, 1983	2,110	26	29	46,000	26,500,000	27.0
		• Yanga, 1979	2,950	48	63	17,000	75,200,000	29.4
		Total Congo		**312**	**392**	**139,269**	**503,045,189**	
DENMARK	**DUC**	• Dan, 1971	6,000- 6,400	41	49	25,386	57,274,190	29.5
		• Gorm, 1971	6,500- 7,000	20	26	23,263	84,058,230	33.9
		• Rolf, 1981	5,900	1	2	6,802	11,910,953	35.3
		• Skjold, 1977	5,000	3	7	38,174	49,052,790	30.3
		• Tyra, 1968	6,500	30	38	18,094	24,131,390	50.4
		Total Denmark		**95**	**122**	**111,719**	**226,427,553**	
DUBAI	**DUPETCO(e)**	• Fateh, 1966	7,900- 9,000	141	156	400,880	2,169,802,600	31.8
		• S.W. Fateh, 1970	7,500- 9,000					30.3
		• Falah, 1972	8,100					25.5
		• Rashid, 1973	9,400-11,500					38.0
	ARCO	Margham, 1981	11,200	8	14	14,520	34,560,000	43.5
		Total Dubai		**149**	**170**	**415,400**	**2,204,362,600**	
ECUADOR	**TEXACO-PETROECUADOR**	Atacapi, 1968	9,855	4	5	1,505	12,762,667	31.0
		Auca, 1970	10,578	23	24	15,701	76,770,667	28.0
		Auca Sur, 1980	9,100-10,300	2	2	614	1,634,667	25.6
		Cononaco, 1972	11,233	9	11	12,785	30,736,000	33.3
		Culebra, 1973	10,626	2	2	1,125	2,578,667	17.5
		Dureno/Guanta, 1968	9,575-10,290	10	10	7,883	8,613,333	31.0
		Lago Agrio, 1967	10,175	18	24	8,738	126,482,667	28.5
		Parahuacu, 1968	10,173	3	5	1,607	7,578,667	30.0
		Rumiyacu, 1982	10,191	...	1	...	184,000	21.0
		Sacha, 1969	10,160	96	103	63,613	406,144,000	28.0

		Name of field, discovery date	Depth, ft	— No. of wells —		— Production —		°API gravity
				Producing	Total	1989 average B/d	Cumulative to Dec. 31, 1989 Bbl	
		Shushufindi/Aguarico, 1959	9,772	52	60	100,953	630,930,667	30.0
		Yuca, 1970	10,423	6	7	2,681	12,352,000	28.0
		Yuca Sur, 1979	9,600-10,000	1	1	351	1,242,667	14.5
		Yulebra, 1980	8,800-10,000	3	3	1,753	3,589,333	21.4
	CICL	Fanny, 1972	7,700	8	8	4,685	12,900,120	22.5
		Mariann, 1971	7,700	5	5	1,048	4,302,980	20.0
		Tarapoa, 1973	8,300	1	2	333	1,150,807	20.0
	CEPE-ORIENT	Bermejo Sur + Norte, 1967	5,000	21	26	5,475	7,572,353	32.5
		Charapa, 1967	10,000	1	4	291	754,353	29.5
		Cuyabeno, 1972	8,050	15	19	7,872	15,752,162	27.4
		Libertador	...	44	50	37,306	77,644,900	29.7
		Tetete-Tapi, 1980	9,300	6	11	2,738	5,961,647	29.1
	CEPE-PENINSULA	Ancon, 1921	4,000	439	439	652		35.7
		Carpet	...	99	99	124	111,600,000	36.4
		Cautivo	...	79	79	112		36.4
		Total Ecuador		**947**	**1,000**	**279,945**	**1,559,239,324**	
EGYPT	**GUPCO/AMOCO**	Abu Gharadig, 1972	9,300-12,000	17	27	11,005	58,691,385	35.0-55.0
		● Badri (315), 1981	6,400	22	38	28,935	67,516,833	27.0
		● El Morgan, 1965	5,000- 7,500	109	126	95,142	1,083,276,893	27.0-32.0
		● GH (376), 1981	8,200- 9,750	1	5	291	6,153,319	24.0-28.0
		● GS (277) 1980	8,610	1	1	1,315	3,331,520	34.0
		● GS (345/346), 1982	7,500	1	2	104	1,225,935	35.0-38.0
		● GS (365), 1980	10,140	1	1	314	679,175	42.0
		● GS (381), 1985	8,700	1	1	1,123	1,333,873	37.0
		● GS-327, 1983	5,600	1	1	1,493	2,621,126	20.0
		● Hilal (404), 1982	9,200-10,000	8	9	30,562	57,463,365	32.0
		● July, 1973	8,100-10,000	27	43	50,979	490,674,420	33.0
		NAG-9/9-1, 1985	10,000	1	2	886	1,624,363	35.0
		NEAG-9/15, 1984	10,635-12,128	...	3	608	1,051,734	35.0
		● Nessim (336), 1981	6,700	1	3	48	8,884,592	29.0
		● October + 173 + 183, 1978	11,000	28	35	128,096	389,875,769	27.0-31.0
		● Ramadan, 1974	11,400	26	30	45,857	395,890,301	30.5
		Razzak and E. Razzak, 1972	5,730- 7,710	12	17	3,145	53,292,886	38.0
		● SB (305), 1981	8,100	...	1	...	2,043,837	27.0
		● SB (339), 1981	4,600	1	1	384	839,058	29.5
		● SB (367), 1984	7,500	1	1	160	1,312,941	39.0
		● SB-294, 1986	11,600	1	2	2,675	2,014,927	30.5
		● SB-374, 1981	...	...	...	...	88,506	...
		● SG-300, 1976	5,720- 6,200	2	4	5,453	22,193,965	24.0
		● Shoab Ali, 1978	4,700- 5,500	19	47	11,115	82,719,926	28.0-33.0
		● Sidki (382), 1977	10,500	5	7	5,642	42,761,720	34.0
		● Waly (356), 1982	6,900	1	3	854	4,248,192	36.0
		WD-33, 1972	9,700	...	1	...	2,161,591	35.0
		WD-33/15, 1985	5,800	2	2	1,908	2,273,047	30.0
		● Younis (347), 1981	4,300	2	6	4,343	15,576,279	32.0
	AGIP	● Belayim Land + Minori, 1954	7,000- 8,500	105	111	12,471	432,550,120	2.5
		Belayim Marine, 1961	8,500	66	74	48,685	627,689,302	9.5
		Meleiha, 1972	5,950	45	54	4,490	11,880,858	1.6
	WEPCO/PHILLIPS PETROLEUM	El Alamein, 1966	8,700	18	19	1,660	67,537,121	34.0
		Umbarka, 1976	10,700	4	5	2,739	7,814,579	44.0
		Yidma, 1971	9,000	3	5	275	21,996,603	43.6
	KHALDA	Hayat, 1986	9,000	5	5	887	750,513	40.0
		Khalda, 1983	7,000	6	13	2,852	2,800,466	35.0
		Safir, 1986	12,000	1	1	528	408,234	36.0
		Safir North, 1986	11,600	3	3	1,863	1,573,662	36.0
		Salam, 1985	8,000	18	29	13,420	14,680,848	35.0
		Tut, 1987	9,000	5	5	1,805	1,301,398	35.0
		Tut West, 1988	9,000	1	1	278	170,132	35.0
	BADR PETROLEUM/SHELL	Badr el din, 1982	10,800	10	10	17,800	27,300,000	38.0
	SUESSO (ESSO)(e)	● East Zeit, 1982	11,000	6	6			38.0
	SUCO(e)	● Ras Budran, 1978	12,500	17	20			23.0-24.0
		● LL 87-2, 1975	12,000	...	1			34.0
		● Ras Fanar, 1978	3,000	5	6			30.0
		● Zeit Bay, 1981	6,000	22	32			34.5
	OSOCO/TOTAL(e)	● Shukheir Bay, 1978	6,300	1	1			34.5
		● S. Ramadan, 1982	10,000	2	2			36.5
	GEYSUM(e)	● Geysum, 1980	5,500	5	5			17.0
	EGPC(e)	Gharib, 1938	2,200- 4,500	81	215			24.3
		Bakr/W. Bakr, 1958/1978	3,200- 1,500	48	83			18.0-19.0
		Umel Yusr, 1968	3,000- 3,300	19	37			21.5
		Amer, 1965	3,500	21	39			21.5
		El Ayoun, 1968	3,300	5	12			22.0
		Kareem, 1958	2,300	6	35			16.6
		Kheir, 1973	1,050	1	4			28.5
		Shukheir, 1966	2,500	5	11			34.0

WORLDWIDE PRODUCTION

		Name of field, discovery date	Depth, ft	No. of wells Producing	No. of wells Total	Production 1989 average B/d	Production Cumulative to Dec. 31, 1989 Bbl	°API gravity
		Ras El Behar, 1983	4,500	6	11	308,810	873,086,730	32.5
		Esh Elmalaha	3,700	2	2			44.0
		Sudr, 1946	2,600	12	20			21.6
		Asl, 1947	3,000	3	6			21.6
		Matarma, 1948	2,000	2	2			14.6
		El Khaligue, 1980	1,600	...	1			29.4
		Abu Senan T&Y, 1981	6,000	12	20			...
		Harghada, 1913	...	NA	NA			...
	EPEDECO(e)	West Bakr, 1978	1,300- 1,500	20	25			18.0
	EGYPTCO(e)	Meleha, 1972	6,000	12	12			40.0
	SHUKAIR MARINE CO.(e)	O. Suco	...	1	1			...
	EL ALAMEIN(e)	Mors	...	1	1			...
		Total Egypt		**896**	**1,364**	**851,000**	**4,893,342,044**	
FRANCE	**ALSACE**	All fields	...	14	21	290	3,158,398	...
		Abandoned	...	...	...	...	24,337,343	...
	AQUITAINE BASIN	Castéra-Lou, 1976	9,600	8	11	382	2,614,350	21.7
		Cazaux, 1959	7,550	36	73	4,451	71,106,450	34.2-37.3
		Lacq Superieur, 1949	2,170	45	71	969	26,213,311	22.3
		Lagrave, 1984	6,500	3	3	6,010	8,017,894	42.5
		Lavergne, 1962	11,460	4	6	338	12,395,156	41.7
		Lugos, 1956	5,250	16	25	461	10,297,730	20.8
		Parentis, 1954	7,710	47	101	5,250	199,906,994	33.4
		Pecorade, 1974	10,660	7	20	1,901	10,631,201	29.3
		Vic Bilh, 1979	7,100	30	47	4,024	18,079,737	26.6
		Other	...	7	12	209	10,386,526	...
		Abandoned	...	...	...	...	8,848,690	...
	PARIS BASIN	Champotran, 1985	8,400	8	13	877	881,462	31.1
		Châteaurenard, 1958	1,800	24	46	371	5,021,062	27.5
		Chaunoy, 1983	7,350	53	78	15,040	27,589,733	37.1
		Chuelles, 1961	1,800	31	68	372	7,135,011	27.5
		Coulommes, 1958	6,230	28	49	345	13,472,866	32.6
		Donmartin-Lettree, 1985	7,020	2	3	578	585,756	35.0
		Donnemarie, 1979	8,040	1	7	395	2,196,663	36.2
		Fontaine-au-Bron, 1986	6,140	10	12	2,280	1,366,704	35.4
		L'ile Du Gord, 1986	7,260	6	6	539	337,188	35.0
		Soudron, 1976	4,600	22	29	381	2,223,037	34.4
		St. Firmin, 1960	1,800	32	62	497	10,148,632	27.5
		St. Germain, 1984	7,200	7	15	955	2,285,843	36.0
		St. Martin, 1959	4,590	9	13	271	8,559,539	33.0
		Vert Le Grand, 1986	6,230	5	6	3,213	2,418,782	34.8
		Villeperdue, 1959	6,100	99	139	12,695	21,412,160	34.4
		Other		78	156	2,461	13,241,027	...
		Abandoned		...	...	...	14,293,157	...
	SOUTHEAST + JURA	All fields abandoned		...	...	...	223,063	...
		Total France		632	1,092	65,555	539,385,435	
GABON	**ELF**	● Anguille, 1962	9,200	218	305	101,215	983,072,000	31.0
		● Anguille W, 1968	7,500					32.3
		● Anguille SE, 1962	8,200					33.0
		● Ayoi Marine, 1979	7,700					19.8
		● Baliste, 1974	4,900					27.5
		● Barbier, 1972	6,000					32.6
		● Batanga, 1960	5,900					39.2
		● Baudroie Marine, 1968	7,500					29.7
		● Baudroie N., 1980	7,500					31.5
		● Breme, 1976	5,000					37.0
		● Clairette, 1956	4,400					32.5
		● Dorée, 1972	7,300					30.4
		● Girelle, 1973	9,400					31.1
		● Gonelle, 1972	5,800					25.7
		● Grand-Anguille, 1983	8,400					31.1
		● Grondin Marine, 1971	7,500					26.6
		● Konzi, 1962	3,600					39.0
		● M'Bya Sud, 1969	6,700					36.2
		● Mandaros, 1973	4,900					20.5
		● Mérou-Sardine, 1981	9,900					30.2
		Olendé, 1976	6,700					34.0
		● Pageau, 1972	11,500					19.8
		● Port-Gentil Sud Marine, 1975	7,500					32.1
		Tchengué, 1957	4,100					31.0
		● Tchengue-Océan, 1962	6,600					30.2
		● Torpille, 1968	8,200					34.0
		● Torpillo NE, 1968	8,200					32.3
	SHELL GABON	Gamba/Ivinga, 1963	3,000- 3,100	51	84	10,685	262,600,000	31.6
		Lucina, 1971	5,900	15	22	7,123	53,800,000	38.4
		Lucina W., 1982	...	...	...	822	2,300,000	38.4

				No. of wells		Production		
		Name of field, discovery date	Depth, ft	Producing	Total	1989 average B/d	Cumulative to Dec. 31, 1989 Bbl	°API gravity
	AMOCO	Oguendjo B, C, and Z, 1981	5,000- 6,000	17	19	13,127	38,091,408	36.0
	BRITISH GAS	● Obando, 1984	8,650	2	2	3,016	1,912,000	32.0
		● Octopus, 1984	10,300	3	3	711	1,166,000	33.0
		● Pelican, 1985	9,300	4	4	7,432	6,004,000	31.0
		Total Gabon		**310**	**439**	**144,131**	**1,348,945,408**	
GHANA	AGRI-PETCO	● Saltpond, 1977	8,500	...	3	...	3,938,000	36.0-39.0
		Total Ghana		...	**3**	...	**3,938,000**	
GREECE	N. AEGEAN PET. CORP.	● Prinos, 1974	8,000- 9,700	13	15	18,222	70,372,217	28.5
		Total Greece		**13**	**15**	**18,222**	**70,372,217**	
GUATEMALA	MINISTERIO DE ENERGIA Y MINAS	Caribe, 1981	6,830	3	3	1,117	3,053,148	22.0-24.0
		Rubelsanto, 1974	5,300	5	7	1,072	6,127,188	26.0-30.0
		San Diego, 1981	17,150	..	1	...	135,865	35.0
		Tierra Blanca	11,230	1	1	760	209,097	19.5-23.0
		Tortugas, 1973	2,300	...	...	...	67,800	25.0
		West Chinaja, 1977	3,200- 3,800	3	3	466	7,337,899	31.0-35.0
		Xan, 1985	8,427	1	1	361	131,773	17.0
		Yalpemech, 1980	15,351	1	1	84	136,957	31.0-35.0
		Total Guatemala		**14**	**17**	**3,860**	**17,199,727**	
INDIA	GUJARAT STATE	Ankleshwar, 1960	1,969- 6,564	138	262	16,962	449,130,000	45.0
		Gandhar, 1984	9,846-12,145	30	52	15,037	9,320,000	47.0
		Kadi, N., 1967	3,610- 7,220	160	227	13,557	11,578,000	21.0
		Kadi, S., 1968	6,892- 9,846	6	39	641	3,812,000	24.0
		Kalol, 1961	4,595-10,830	152	322	11,719	42,278,000	38.0
		Nawagam, 1963	4,595-10,174	74	130	2,733	26,832,000	31.0
		Sanand, 1962	4,267-10,174	22	88	2,095	10,317,000	26.0
		Sobhasan, 1968	4,595- 9,846	59	124	12,460	25,714,000	26.0-40.0
		Viraj, 1978	4,595- 4,923	20	37	3,700	5,148,000	20.0
	ASSAM STATE	Geleki, 1968	9,518-14,769	62	161	9,144	40,579,000	30.0
		Lakwa-Lakhmani, 1964	6,564-14,113	211	344	37,419	154,469,000	33.0
		Rudrasagar, 1960	7,877-13,128	50	111	10,689	37,708,000	25.0
	WEST COAST	● B-38 (Heera), 1977	4,267- 6,564	40	76	28,836	56,379,000	37.0
		● Bombay High, 1974	3,282- 7,877	304	450	420,179	1,255,890,000	39.0
		● Panna (North Bassein), 1976	4,923- 7,549	7	23	2,978	1,691,000	38.0
		● Ratna, 1979	7,500	5	14	1,307	957,000	38.0
	NAGALAND & TAMIL NADU	Changpang, 1973	8,861-10,502	9	17	3,002	4,857,000	34.0
		Narimanam, 1985	6,236- 7,549	8	25	2,818	1,258,000	45.0
	OTHER FIELDS	Bakrol, 1966	2,626- 9,846	...	3	...	37,000	...
		Digboi, 1980	300- 7,500	234	462	570	86,156,400	...
		Jorajan, 1967	7,000-11,500	126	187	23,248	52,560,000	25.0-34.0
		Kathana, 1965	5,250- 5,906	13	33	547	5,103,000	25.0
		Kholka, 1966	5,579- 7,877	12	19	144	636,000	...
		Kosamba, 1963	1,313- 8,533	6	23	393	978,000	...
		Moran, 1958	11,000	61	89	8,286	109,287,600	...
		Nakhorkatiya, 1953	9,500	135	325	21,367	367,974,000	...
		Wavel, 1962	4,595- 7,220	...	...	...	168,000	...
		Total India		**1,944**	**3,643**	**649,831**	**2,760,817,000**	
INDONESIA	PERTAMINA UEP I(e)	Besitang, 1977	3,973					51.5
		Gebang, 1977	2,917					54.0
		K. Simpang, 1971	3,740- 5,019					45.0
		P. Tabuhan, 1937	3,350- 5,893	204	226			50.8
		Rantau, 1929	2,764					45.3
		Serang Jaya, 1926	3,701					47.5
	PERTAMINA UEP II(e)	Benuang, 1942	6,103					35.1
		Benakat East, 19[illegible]3	NA					NA
		Tempino, 1931	1,647					23.0
		Gn. Kemala, 1938	5,448					38.0
		Limau, 1928	3,896- 4,626					NA
		Ogan Timur, 1943	3,793					27.42
		Talang Jimar, 1937	4,123	412	1,419			31.0
		T. Miring, 1935	640					NA
		Tanjung Tiga, 1938	3,750					28.0
		Kenali Asam, 1931	2,077					29.0
		Belimbing	5,371					...
		Kuang, 1940	5,249					25.1
	PERTAMINA UEP III(e)	Cemara, 1976	3,964- 7,104					...
		Jatibarang, 1969	3,063	88	184			29.0
		Tugu Barat, 1979	3,014					...
	PERTAMINA UEP IV(e)	Bunyu, 1923	2,077					33.2
		Sangatta, 1939	1,842					33.0

			No. of wells		Production		
	Name of field, discovery date	Depth, ft	Producing	Total	1989 average B/d	Cumulative to Dec. 31, 1989 Bbl	°API gravity
	Tanjung, 1938	2,296	161	334	7,701	2,955,200,548	39.9
	Tapian Timur, 1967	4,396					38.8
	Warukin S., 1966	2,067					26.9
PERTAMINA UEP V(e)	Klamono, 1936	574					19.0
	Linda, 1977	3,281	47	55			19.0
	Sele, 1951	2,156					35.0
PERTAMINA (FROM STANVAC)(e)	Sago, 1940	1,800					34.0
	Linik, 1939	1,600					34.0
	Molek, 1956	2,600					34.0
	N. Pulai, 1941	1,800					34.0
	S. Pulai, 1941	1,800	354	354			34.0
	Talang Akar, 1922	2,800					35.0
	Benakat, 1932	1,600					35.0
	Jirah, 1930	2,300					35.0
	Rajah, 1940	6,000					36.0
	Abab, 1951	6,000					36.0
PERTAMINA (N.E. KALIMANTAN)(e)	Sembakung, 1976	2,600	17	19			36.0
	Bangkudulis, 1980	3,250	...	1			39.5
PERTAMINA (FROM PHILLIPS)(e)	Salawati, 1976	5,749	7	13			39.2
LEMIGAS(e)	All fields, 1893-1909	2,155- 2,297	71	419			...
TOTAL CFP(e)	• Tambora, 1980	8,000-13,000	15	34			33.0
	• Handil, 1974	2.900- 9,000	219	272			33.0
	• Bekapai, 1972	4,600- 5,600	42	45			40.0
ARCO	Ardjuna, 1969	2,380- 7,250	300	356	99,438	722,948,500	37.0
	Arimbi, 1972	2,943	27	30	9,919	29,953,200	33.0
	NWC, 1974	5,411-5,800	17	30	5,746	7,041,700	31.5
	Bima, 1983	3,000- 3,888	48	60	11,947	15,896,200	34.0
AGL PETROLEUM (SERAM) LTD.	Bula, 1897	280- 1,300	131	69	1,295	15,542,593	23.0
CHEVRON & TEXACO	Batang, 1975	690	12	13	701		19.0
	Benua, 1978	2,400	21	25	10,114		37.0
	Beruk, 1974	1,750	19	28	8,813		38.0
	Beruk NE, 1976	1,800	3	6	138		40.0
	Beruk North, 1985	1,900	5	7	1,174		38.0
	Buaya, 1978	2,035	...	2	...		28.0
	Butun, 1982	4,000	9	9	5,781		44.0
	Damar, 1974	4,650	5	6	511		34.0
	Dusun, 1979	2,550	6	7	1,008		42.0
	Gatam, 1977	2,385	...	3	...		34.0
	Idris, 1982	2,450	1	3	815		39.0
	Kasikan, 1972	660	20	27	1,156		28.0
	Jingga, 1984	6,500	3	3	1,596		45.0
	Langgak, 1976	1,380	26	27	2,340		32.0
	Lindai, 1971	1,100	18	20	1,386		32.0
	Menggala S., 1968	3,765	2	3	755		34.0
	Mengkapan, 1981	4,000	1	1	767		44.0
	Osam, 1978	900	6	6	298		32.0
	Paitan, 1978	2,315	1	1	232		32.0
	Pedada, 1973	950	30	31	11,032		33.0
	Pusaka, 1977	2,250	20	23	5,985		36.0
	Rintis, 1984	6,450	1	1	387		39.7
	Sabak, 1974	2,350	15	17	1,650		36.0
	Tanjung Medan, 1976	2,770	2	7	846		34.0
	Terantam, 1973	900	2	4	109		32.0
	Zamrud, 1975	3,600	52	54	19,295		40.0
CALTEX PACIFIC INDONESIA	Central Sumatra, Aman, 1974	4,700	10	10	1,360		39.0
	Ampuh, 1981	6,000	12	12	2,825		38.0
	Antara, 1978	1,425	5	6	939		36.0
	Balam S., 1969	1,600	59	62	9,141		33.0
	Balam SE, 1972	4,500	13	13	666		29.0
	Bangko, 1970	1,950	86	96	28,311		34.0
	Batang CPI, 1975	690	6	7	370		19.0
	Bekasap, 1955	2,950	56	63	18,708		34.0
	Bekasap South, 1968	3,900	9	14	1,199		34.0
	Benar, 1973	2,450	26	30	4,778		33.0
	Cebakan, 1974	4,700	4	5	627		30.0
	Cucut, 1981	5,800	3	3	221		33.0
	Duri, 1941	770	1,465	1,844	134,071		22.0
	Garuk, 1980	4,600	...	2	...		31.0
	Hitam, 1975	6,690	4	5	979		39.0
	Hiu, 1983	5,900	4	4	1,125		40.0
	Intan, 1977	3,350	6	7	1,866		33.0
	Jorang, 1972	5,500	19	21	11,612		38.0
	Kerang, 1977	3,900	11	14	1,032		39.0
	Kopar, 1974	5,300	20	23	3,696		37.0
	Kotabatak, 1952	5,500	68	113	18,818		29.0
	Kulin, 1970	2,050	60	68	4,996		20.0
	Libo, 1968	6,000	2	12	1,401		35.0
	Libo SE, 1973	5,900	20	27	7,458		42.0

	Name of field, discovery date	Depth, ft	No. of wells Producing	No. of wells Total	Production 1989 average B/d	Production Cumulative to Dec. 31, 1989 Bbl	°API gravity
	Lincak, 1981	2,570	4	4	323		35.0
	Menggala N., 1968	3,850	16	20	4,336		33.0
	Menggala S. CPI, 1968	3,765	6	7	1,449		34.0
	Minas, 1944	2,600	467	618	232,966	6,749,434,683	35.0
	Mindal, 1971	3,400	2	4	37		37.0
	Mutiara, 1976	3,500	2	2	...		34.0
	Nella, 1977	5,000	3	5	33		35.0
	Obor, 1978	7,370	2	2	201		40.0
	Pager, 1974	4,300	25	27	6,930		38.0
	Pelita, 1977	6,600	7	7	627		39.0
	Pematang, 1959	3,750	40	46	8,538		32.0
	Pematang Bow, 1969	5,300	7	14	1,997		33.0
	Pemburu, 1981	2,300	9	10	2,738		35.0
	Perkebunan, 1977	2,300	1	1	...		29.0
	Petani, 1964	4,750	31	34	11,419		33.0
	Petapahan, 1971	4,500	23	30	5,051		28.0
	Pinang, 1971	3,950	19	22	4,690		30.0
	Pinggir, 1972	3,300	3	7	268		35.0
	Pinggir S., 1973	3,300	2	4	59		39.0
	Pudu, 1972	5,950	8	13	1,060		35.0
	Pukat, 1983	6,200	2	2	813		40.0
	Puncak, 1979	2,400	14	16	3,788		36.0
	Pungut, 1951	3,400	27	33	4,202		38.0
	Rangau, 1968	6,100	4	12	113		42.0
	Rantaubais, 1972	1,070	14	18	541		18.0
	Rokiri, 1979	6,100	...	4	...		41.0
	Seruni, 1972	3,000	23	25	6,796		35.0
	Sikladi, 1975	4,340	19	21	2,869		40.0
	Singa, 1977	3,200	1	1	32		31.0
	Sintong, 1971	3,400	22	23	3,497		32.0
	Sintong SE, 1973	4,500	1	1	78		36.0
	Suram, 1971	1,750	4	7	238		28.0
	Tandun, 1969	3,000	12	13	2,675		33.0
	Telinga, 1975	4,205	7	10	603		33.0
	Topaz, 1977	5,200	7	8	1,558		33.0
	Topi, 1979	3,630	1	1	3		37.0
	Tunas, 1983	4,819	2	2	101		35.0
	Ubi, 1976	4,350	24	25	2,878		35.0
	Waduk, 1982	6,100	9	11	212		38.0
ASAMERA (NORTH SUMATRA)	Alur Cimon, 1972	3,098	...	24	...	1,378,939	50.8
	Geudondong, 1965	3,192	...	23	...	5,199,661	53.1
	Iee Tabeu, 1971	2,721	1	47	33	11,903,005	50.3
	Julu Rayeu, 1968	2,832	7	47	138	12,422,881	53.6
	Peudawa, 1980	3,083	...	10	...	1,567,420	48.1
	Tualang, 1973	2,631	11	58	1,021	30,856,147	49.9
ASAMERA (SOUTH SUMATRA)	Bentayan, 1932	4,446	16	18	2,037	2,366,357	22.0
	Kluang, 1913	2,591	26	70	476	34,233,038	42.6
	Mangunjaya, 1934	2,700	5	102	152	23,141,435	32.0
	Panerokan, 1976	4,915	2	5	21	206,837	39.4
	Ramba, 1982	3,150	62	74	12,288	55,475,598	37.0
	Rawa, 1985	4,038	26	34	6,138	6,487,085	38.7
	Tanjung Laban, 1982	3,590	21	29	3,994	8,162,791	38.1
	Tempino, 1931	4,493	3	6	128	1,447,940	40.9
	Keri, 1985	3,957	2	2	67	103,940	41.5
	Supat, 1984	4,626	11	11	1,679	984,286	33.6
	South Rawa, 1985	4,086	2	3	76	69,888	37.0
MAXUS ENERGY	● Cinta, 1970	3,500	41	50	11,689	180,237,816	34.0
	● Duma, 1983	2,300	2	6	135	747,577	24.0
	● Farida, 1982	8,000	15	22	3,348	12,854,871	32.0
	● Gita, 1972	5,000	5	9	623	7,732,447	34.5
	● Intan, 1989	...	9	9	17,910	6,537,400	32.6
	● Karmila, 1983	4,800	6	9	7,095	32,317,970	36.0
	● Kitty, 1973	2,700	7	7	1,120	14,382,111	38.0
	● Krisna, 1979	4,500	31	41	7,017	62,216,480	37.0
	● Nora, 1973	3,200	4	5	424	8,962,055	29.0
	● Rama, 1974	3,200	40	76	6,498	93,558,502	31.0
	● Selatan, 1971	4,000	8	19	1,030	21,173,656	19.0
	● Sundari, 1982	4,400	12	15	2,630	11,825,368	25.0
	● Titi, 1982	8,000	1	4	10	1,636,229	33.0
	Wanda, 1984	4,800	2	5	140	1,636,933	36.0
	● Yvonne, 1980	4,500	8	11	3,023	13,724,355	36.0
	● Zelda, 1971	7,500	30	45	6,899	39,165,810	33.0
PETROMER TREND	Cenderawasih, 1976	3,500	18	24	1,554	12,861,086	26.7
	Jaya, 1973	3,050	12	19	1,033	36,178,946	39.7
	Kasim, 1972	3,350	38	54	3,475	48,509,708	36.5
	Walio, 1975	2,750	210	288	13,312	156,932,595	34.3
	Other	...	12	21	998	12,685,379	...
STANVAC (CENTRAL SUMATRA)	Binio, 1972	1,600	19	19	423	11,975,355	34.0
	E. Kayuara, 1983	3,500	45	45	4,010	8,513,939	35.0
	Gemuruh, 1983	2,800	14	16	968	2,740,506	34.0
	Kayuara, 1982	3,700	7	9	337	2,150,314	35.0

		Name of field, discovery date	Depth, ft	No. of wells Producing	No. of wells Total	Production 1989 average B/d	Production Cumulative to Dec. 31, 1989 Bbl	°API gravity
		Kerumutan, 1980	3,000	19	21	764	5,399,906	35.0
		Merbau, 1979	2,700	28	28	989	7,132,070	36.0
		Mutiara, 1985	2,700	2	2	48	132,620	34.0
		N. Merbau, 1980	2,600	8	8	278	2,936,676	36.0
		Parum, 1987	4,200	9	9	2,063	1,383,769	35.0
		Panduk, 1981	2,500	6	6	224	1,609,536	46.0
		Pekan, 1976	3,700	18	18	393	7,983,900	35.0
		Other	4,600	...	...	...	9,175	–
	STANVAC (SOUTH SUMATRA)	Ibul, 1970	5,700	17	17	780	22,193,660	36.0
		Jene, 1985	6,500	22	25	23,765	21,443,720	35.0
		● Kerang (PSC), 1984	2,900	4	5	1,165	1,173,757	35.0
		Lagan, 1986	2,400	4	4	270	303,574	56.8
		Pian, 1986	6,000	3	3	92	97,189	36.0
		Rambutan, 1972	4,500	6	6	66	3,246,970	42.0
		Rimbabat (PSC), 1984	3,200	3	3	366	160,980	34.0
		● Tabuan (PSC)	4,000	9	9	748	1,817,026	34.0
		Other	4,500	6	6	1,060	2,383,653	–
	UNION TEXAS	Badak, 1972	5,190-10,600	122	146	5,389	412,604,000	21.0
		Mutiara, 1984	900- 5,800	9	31	2,948	5,012,000	30.0
		Nilam, 1974	7,500-11,500	72	101	5,088	22,231,000	32.0
		Pamaguan, 1974	900- 5,100	13	26	2,197	7,424,000	30.0
		Semberah, 1974	2,900-10,100	...	29	...	7,000	35.0
	UNOCAL	● Attaka, 1970	7,500	78	101	51,117	470,523,474	39.0
		● Kerindingan, 1972	7,000	...	8	255	5,038,870	23.8
		● Melahin, 1972	7,500	4	6	750	6,787,008	23.1
		● Rajah, 1981	5,500	6	6	4,481	6,023,749	33.8
		● Sepinggan, 1973	11,150	16	20	4,707	45,421,669	34.0
		● Yakin, 1976	5,100	21	28	7,194	23,614,688	18.8
	CONOCO GROUP	● Ikan Pari, 1983	4,500	4	4	2,164	790,031	47.0
		● Kepeting, 1982	6,000	...	2	826	2,563,162	37.0
		● Udang, 1974	5,595	18	28	5,812	59,583,697	40.0
	MOBIL OIL	Arun, 1971	10,000	46	62	124,267	381,192,417	55.0
	MARATHON	● Kakap KH, 1980	8,500	8	8	6,900	15,559,000	45.0
		● Kapap KF, 1984	8,100	1	1	2,800	67,000	49.0
	HUDBAY (MALACCA STRAIT)	● Kurau, 1986	4,500- 9,000	15	17	26,680	12,929,507	47.4
		● Lalang, 1980	3,100- 3,600	11	18	7,485	36,401,391	39.6
		● Melibur, 1984	900- 1,300	12	19	8,740	9,134,245	35.6
		● Mengkapan, 1981	3,850- 4,450	9	10	15,396	20,498,509	42.0
	TESORO INDONESIA PETROLEUM	Samboja, 1909	360- 4,380	26	99	363	64,762,820	25.0
		Sanga Sanga, 1897	85- 6,000	108	244	2,540	268,598,560	31.0
		Tarakan, 1906	200- 6,540	122	1,167	1,785	211,485,507	19.0
	TARAKAN PETROLEUM	Tarakan (Mamburungan field), 1984	5,020- 5,131	2	4	471	99,522	31.1
		Total Indonesia		**6,963**	**11,568**	**1,231,000**	**13,229,992,828**	
IRAN	**NIOC**	● Aboozar, 1969	2,800	...	...	2,801,370	37,992,437,094	27.0
		Agha Jari, 1936	7,440	58	89			34.0
		Ahwaz Asmari, 1958	8,150	73	85			32.0
		Ahwaz Bangestan, 1958	12,000	...	7			24.3
		● Bahregansar, 1960	9,000	...	...			30.0
		Bibi Hakimeh, 1961	4,570	19	33			29.9
		Binak, 1959	10,440	...	4			29.9
		Chesmeh Khush, 1967	10,700	...	4			27.7
		Chillingar, 1974	3,350	...	1			39.3
		Dehluran, 1972	11,900	...	6			31.0
		● Dorood, 1961	11,000	...	...			34.0
		● Forozan, 1966	7,000	...	...			28.5
		Gachsaran, 1937	3,400	46	62			31.0
		Haft Kel, 1927	1,980	2	11			37.7
		● Hendijan, 1968	11,000	...	...			23.0
		Karanj, 1963	5,360	7	7			33.9
		Kharg, 1961	10,900	...	...			31.6
		Kupal, 1965	10,500	...	7			32.8
		Lab-e Safid, 1968	4,350	...	7			35.3
		Mansuri, 1963	7,100	4	8			28.4
		Marun, 1963	9,400	55	112			32.6
		Masjid-e Suleiman, 1908	1,600	7	24			39.3
		Naft Safid, 1938	5,000	5	19			36.8
		Naft-Shahre, 1923	2,000- 3,000	...	...			43.0
		● Nowruz, 1966	8,200	...	...			21.0
		Parsi, 1964	4,670	22	27			38.8
		Par-e Siah, 1964	4,250	...	1			37.7
		Pazanan, 1961	7,250	44	71			37.2
		Rag-e Safid, 1964	7,230	19	29			28.6
		Ramin, 1966	12,200	...	...			32.9
		Ramshir, 1962	8,750	...	3			27.6
		● Resalat, 1969	7,650	...	...			35.8
		● Reshadat, 1966	7,000	...	...			34.4

				No. of wells		Production		
		Name of field, discovery date	Depth, ft	Producing	Total	1989 average B/d	Cumulative to Dec. 31, 1989 Bbl	°API gravity
		● Soroush, 1962	7,000	...	...			18.3
		● Salman, 1965	7,500- 8,100	...	...			34.0
		Shadegan, 1989	...	...	...			...
		Sulabedar, 1971	3,400	...	1			30.4
		Total Iran		**361**	**618**	**2,801,370**	**37,992,437,094**	
IRAQ(e)	INOC	Abu Ghurab, 1971	9,800	12	16	2,897,000	21,671,213,000	24.0
		Ain Zalah, 1939	5,200- 6,500	15	28			31.0
		Bai Hassan, 1953	4,800- 5,400	55	84			34.0
		Balad, 1983	6,000- 7,000	4	8			25.0
		Butmah, 1953	3,900	1	17			31.0
		Buzurgan, 1970	12,000	20	22			24.0
		East Baghad, 1975	6,000- 7,000	32	79			23.0
		Hamrin, 1973	2,000	...	14			30.0
		Jabal Fauqui, 1974	10,000	20	23			25.5
		Jambur, 1954	5,500-12,500	27	50			38.0
		Kirkuk, 1927	2,800- 4,200	71	269			36.0
		Luhais, 1961	8,200	12	21			33.0
		Naft Khaneh, 1909	3,500	7	11			42.5
		Nahr Umar, 1949	8,200	5	13			42.0
		Qaiyanah, 1929	650	33	50			16.0
		Rumaila North, 1958	10,300	303	443			33.0
		Rumaila South, 1953	10,200	133	208			34.0
		Suffayah, 1978	3,900	11	39			25.0
		West Tikrit, 1985	8,200	2	6			23.0
		Zubair, 1949	10,200	56	110			35.0
		Total Iraq		**820**	**1,511**	**2,897,000**	**21,671,213,000**	
ISRAEL(e)	LAPIDOTH	Heletz-Brur, 1955	5,200	4	18	280	16,840,000	29.2
		Kochav, 1962	5,500	6	13			27.9
	OEIL	Ashdod, 1976	8,400	2	2			32.5
	EMOG	Gurim, 1984	3,280	...	...			17.0
		Total Israel		**12**	**33**	**280**	**16,840,000**	
ITALY	ELF	● Rospo Mare, 1975	4,600	14	16	20,576	24,547,151	12.2
		● Santa Maria a Mare, 1974	7,900	8	12	833	17,986,522	22.3
		● Sarago Mare, 1979	5,200	5	6	4,519	11,333,805	8.1
	AGIP	Benevento, 1974	6,599	1	1	493	325,713	39.0
		Cavone, 1979	10,663-18,068	13	15	2,993	8,713,259	24.0
		Cela Mare	10,300	12	18	1,623	15,289,898	10.0
		Emilio S., 1971	9,215	...	1	...	337,266	13.0
		Gaggiano, 1982	13,766	2	2	260	455,537	37.0
		Gela, 1956	11,280-11,350	53	68	6,995	105,404,448	10.0
		Malossa, 1973	17,881-21,231	5	8	628	20,138,309	55.0
		Narciso, 1985	2,650	...	1	...	337,622	21.1
		Nilde, 1977	4,545	2	3	240	19,716,499	38.9
		Perla, 1976	7,850	4	4	404	1,921,622	13.3
		Pisticci-S. Cataldo, 1960	6,820- 6,880	8	12	1,248	8,356,978	11.4
		Prezioso, 1982	16,400	3	3	3,004	1,342,326	10.0
		Ragusa, 1954	5,760	37	37	4,054	129,361,392	19.5
		S. Maria Inbaro, 1985	6,520	3	4	130	360,273	15.9
		V. Fortuna, 1984	19,828	3	4	9,929	5,263,951	46.0
		Other	...	25	63	1,959	21,508,279	...
	MONTEDISON(e)	● Vega	...	...	...	23,112	21,635,880	...
		Total Italy		**198**	**346**	**83,000**	**420,336,730**	
IVORY COAST	SIOP	● Belier, 1975	6,500- 7,000	13	18	2,112	18,391,119	34.5
	PETROCI	● Espoir, 1980	6,500-11,000	...	...	...	31,102,952	32.3
		Total Ivory Coast		**13**	**18**	**2,112**	**49,494,071**	
JAPAN	JAPEX	● Aga-Oki, 1972	7,590	7	7	710	3,293,421	24.8
		Higashi-Niigata, 1965	4,500- 9,200	19	29	577	7,856,914	53.9
		Katakai, 1960	3,310-16,300	5	16	498	775,384	50.0
		Sarukawa, 1958	2,000- 3,200	62	134	1,280	18,704,187	32.3
		Yoshii, 1968	8,000	9	25	661	9,110,857	61.8
		Yurihara, 1976	1,310- 7,610	10	15	266	494,299	43.5
		Other	...	56	75	321	21,199,489	...
	IDEMITSU OIL DEVELOPMENT CO. LTD.	● Agaoki-Kita, 1982	4,950	10	10	2,364	6,500,000	37.0
	TEIKOKU	Hagashi-Kashiwazaki, 1970	6,000- 8,900	5	10	495	8,292,629	62.0
		Kubiki, 1959	1,100- 6,400	95	134	699	11,825,071	29.7
		Minami-Aga, 1964	7,300- 9,600	11	35	512	14,010,670	38.5
		Minami-Nagaoka, 1984	13,200-15,100	5	13	542	1,098,164	55.7
		Yabase, 1933	1,100- 5,800	59	80	394	33,359,850	33.0
		Other	...	15	15	121	3,340,006	...
		Total Japan		**368**	**598**	**9,440**	**139,860,491**	

		Name of field, discovery date	Depth, ft	No. of wells Producing	No. of wells Total	Production 1989 average B/d	Production Cumulative to Dec. 31, 1989 Bbl	°API gravity
JORDAN	NRA	Hamzah, 1984	9,500	4	17	400	57,400	30.0
		Total Jordan		**4**	**17**	**400**	**57,400**	
KUWAIT[e]	KOC	Burgan, 1938	4,800	210	393	1,593,000	23,720,053,000	30.8
		Ahmadi, 1952	4,800	11	84			31.7
		Magwa, 1951	4,800	71	113			33.0
		Raudhatain, 1955	8,600	41	53			34.4
		Bahra, 1956	8,500	...	2			...
		Sabriya, 1957	8,300	9	44			36.3
		Minagish, 1959	10,000	1	21			34.4
		Umm Gudair, 1962	9,000	20	33			26.9
		Total Kuwait		**363**	**743**	**1,593,000**	**23,720,053,000**	
LIBYA	AGIP	Bu Attifel, 1968	14,300	33	40	77,464	856,523,977	41.0
		Rimal Katib, 1965	14,000	6	7	2,335	7,405,965	35.0
		• Bouri	8,700	24	24	7,348	4,359,195	26.0
	ELF[e]	El Meheinga	10,500	1	2	1,042,853	16,053,641,115	46.0
	LNOC[e]	Arshad, 1966	10,100	491	491			42.0
		Jebel, 1962	8,100					38.0
		Majid, 1968	9,000- 9,800					...
		Don Mansour Unit	5,600					...
		Nasser, 1959	5,500- 7,600					38.0
		Lehib-Dor Marada Unit, 1965	9,500					50.0
		Raguba, 1961	5,400					43.0
		Beda, 1959	4,000					36.0
		Bualawn, 1972	6,000					40.0
		Dor, 1967	6,400					33.2
		Kotla, 1963	5,500					34.0
		Sahabi B & D, 1961	9,000-10,000					39.0
		Sarir, 1961	9,000					37.2
		Amal, 1959	9,900					37.5
		Ora, 1962	7,250					40.2
		Ghani, 1978	6,000					40.0
		Bahi, 1968	3,500- 3,750					43.4
		Belhedan, 1962	7,000					33.6
		Dahra, 1959	3,100- 3,700					37.0-41.0
		Defa, 1969	5,400- 5,900					35.6
		Gialo, 1961	2,200- 6,300					35.7
		Harsh, 1978	7,400					34.6
		Khalifa, 1978	5,400- 7,000					34.6
		Masrab, 1978	10,000					39.6
		Samah, 1961	9,000					33.4
		Waha, 1960	6,000					36.0
		Zaggut, 1962	6,000					36.4
		Balat, 1983	5,100- 5,400					32.2
		Ali, 1975	3,900	1	2			50.0
		Almas, 1975	4,000	5	8			49.5
		Intisar A, 1967	9,750	8	19			45.0
		Intisar B, 1974	9,600	2	2			50.0
		Intisar C, 1967	9,650	1	6			37.5
		Intisar D, 1967	9,400	19	27			39.0
		Intisar E, 1968	5,300- 7,100	8	11			34.7
		Nafoora-Augila, 1966	2,200-10,000	13	55			35.5
		Aswad, 1978	6,250	8	8			46.0
		Sabah, 1977	5,500	36	38			42.0
		Zella, 1977	6,750	27	31			48.1
		Other	7,900- 8,900	1	2			40.4
		Fidaa, 1979	7,000	9	9			41.7
		Hakim, 1978	6,700	3	3			48.5
		Total Libya		**696**	**783**	**1,130,000**	**16,921,930,252**	
MALAYSIA	ESSO MALAYSIA	• Bekok, 1976	5,500	22	33	315,000	820,000,000	47.0
		• Guntong, 1978	5,200	56	91			44.0
		• Irong Barat, 1979	3,300	9	18			35.0
		• Kepong, 1979	6,000	...	11			47.0
		• Palas, 1979	6,[illegible]00	13	18			49.0
		• Pulai, 1973	4,300	22	32			42.3
		• Seligi, 1971	4,300	16	22			50.0
		• Semangkok, 1980	3,700	31	41			42.5
		• Tabu, 1978	5,600	15	24			44.0
		• Tapis, 1975	6,700	41	80			45.0
		• Tinggi, 1980	4,400	21	27			48.0
		• Tiong, 1978	5,800	20	41			47.0
	SARAWAK SHELL BERHAD	• D-18, 1981	4,000	5	5	3,550	2,899,000	39.9
		• Bayan, 1976	4,200	7	9	13,110	26,498,000	37.3
		• Temana, 1972	3,100	19	29	9,560	40,199,000	35.0
		• Other	5,600-11,000	29	33	10,930	268,726,000	...

WORLDWIDE PRODUCT[illegible]

		Name of field, discovery date	Depth, ft	No. of wells — Producing	No. of wells — Total	Production — 1989 average B/d	Production — Cumulative to Dec. 31, 1989 Bbl	°API gravity
	SABAH SHELL	● Barton, 1971	2,400	4	4	3,010	10,402,000	37.0
		● Erb West, 1977	6,785	15	19	6,630	21,620,000	30.0
		● Ketam, 1977	4,800	1	4	270	999,000	30.0
		● Samarang, 1972	5,700	56	80	59,840	257,301,000	37.0
		● South Furious, 1974	3,300	7	15	3,010	13,499,000	30.0
		● St. Joseph, 1975	2,200	11	14	16,360	20,271,000	32.0
	PETRONAS CARIGALI(e)	● Tembungo, 1971	6,000	8	16	125,730	577,182,000	40.0
	SARAWAK SHELL/PETRONAS CAG.(e)	● Bakau	...	...	...			...
		● Baram	...	...	...			...
		● Baronia, 1967	7,900	19	40			42.0
		● Betty, 1967	7,900	13	17			38.0
		● Bokor, 1972	2,000	18	19			35.0
		● Fairley Baram, 1973	8,655	...	2			39.5
		● Siwa, 1973	4,100	4	4			25.0
		● Tukau, 1966	5,000	26	48			29.2
		● West Lutong	...	...	...			39.5
		~~Total Malaysia~~		508	796	567,000	1,990,000,000	
MEXICO(e)	NORTH ZONE, NE	Misión, 1945	5,440	4,740	4,740	41,200	16,547,594,500	...
		Monterrey, 1950	6,510					...
		Tigrillo, 1971	3,342					...
	NORTH ZONE, N.	● Arenque, 1970	11,362					26.0
		Constituciones, 1956	6,350					17.0
		Ebano-Pánuco, 1901	1,450					12.0
		Tamaulipas	4,200					19.0
	NORTH ZONE, S.	Chicontepec, 1973	4,264					34.1
		● Isla de Lobos, 1963	6,875					40.0
		● Marsopa, 1974	10,198					39.0
		Naranjos-C. Azul, 1909	1,800					22.0
		Tres Hermanos, 1959	6,960					21.0
		Other	...					...
	CENTRAL ZONE, POZA RICA	● Atún, 1966	9,040			57,700		37.0
		● Bagre, 1973	10,919					33.0
		Escolín, 1942	7,216					26.3
		Hallazgo, 1955	10,170					25.0
		Jiliapa, 1958	7,390					24.0
		Mecatepec, 1941	7,544					29.8
		Miquetla, 1959	6,480					35.0
		Poza Rica, 1930	7,090					35.0
		Pres. Alemán, 1949	8,036					26.0
		Remolino, 1962	10,745					29.5
		San Andrés, 1956	10,410					29.0
		Other	...					...
	CENTRAL ZONE, CUENCA DEL PAPALOAPAN	Matapionche, 1974	11,129					35.6
		Other	...					...
	CENTRAL ZONE, N. FAJA DE ORO	Acuatempa, 1955	4,085					21.0
		Muro, 1965	3,966					17.0
		Ordónez, 1952	5,220					21.0
		Ocotepec, 1953	3,737					20.0
		Santa Agueda, 1953	4,780					16.0
		Other	...					...
	SOUTHERN ZONE, NANCHITAL	Ixhuatlán Ote., 1965	1,960			65,400		22.6
		Moloacán, 1962	500					22.3
		Santa Rosa, 1952	1,312					25.4
	SOUTHERN ZONE, EL PLAN	Agata, 1956	3,830					...
		Bacal, 1976	3,500					35.0
		Concepción, 1974	1,600					31.0
		Cuichapa, 1935	2,200					30.0
		El Plan, 1931	1,700					30.0
		Lacamango, 1973	1,700					26.3
		Los Soldados, 1953	4,492					32.0
		Other	...					...
	SOUTHERN ZONE, AGUA DULCE	Blasillo, 1967	7,216					40.0
		Cinco Presidentes, 1960	6,862					35.0
		Burro, 1931	2,200					26.0
		Venta, 1954	4,730					41.0
		Ogarrio, 1957	5,790					38.0
		Otates, 1965	7,469					39.0
		Rodador, 1971	11,398					26.0
		Sánchez Magallanes, 1957	4,240					27.0
		San Ramón, 1967	9,517					30.0
		Tonalá, 1928	1,770					28.0
		Other	...					...
	SOUTHEAST ZONE, COMALCALCO	Agave, 1977	13,450					41.7
		Arroyo Zanapa, 1978	14,599					38.9
		Arteza, 1977	11,800					26.4

		Name of field, discovery date	Depth, ft	No. of wells Producing	No. of wells Total	Production 1989 average B/d	Production Cumulative to Dec. 31, 1989 Bbl	°API gravity
		Ayapa, 1972	8,200			607,200		7.2
		Cacho López, 1977	14,250					29.0
		Cáctus, 1972	14,100					31.5
		Carrizo, 1962	3,500					23.3
		Castarrical, 1967	10,080					29.3
		Comoapa, 1979	14,432					44.5
		Copano, 1977	11,890					43.9
		Cunduacán, 1974	13,775					28.9
		El Golpe, 1963	3,500					25.7
		Giraldas, 1977	15,225					37.0
		Iride, 1974	13,775					28.5
		Muspac, 1982	9,676					57.0
		Mecoacán, 1957	2,200					8.6
		Mora, 1981	...					38.1
		Mundo Nuevo, 1977	11,800					46.0
		Níspero, 1974	14,100					34.4
		Paredón, 1978	15,690					39.8
		Oxiacaque	11,150					29.1
		Platanal, 1978	15,900					30.2
		Río Nuevo, 1975	14,950					34.8
		Samaria (Cret), 1973	14,209					31.0
		Santuario, 1966	9,617					37.0
		Sitio Grande, 1972	13,766					35.0
		Sunuapa, 1978	12,887					32.8
		Tapijualpa, 1982	15,613					39.8
		Tintal, 1968	5,904					22.0
		Topén, 1978	11,172					25.4
		Tupilco, 1959	9,685					27.0
		Bellota, 1982	17,056					41.0
		Cardenas, 1979	17,548					38.0
		Chiapas, 1979	12,136					42.0
		Fenix, 1979	17,876					40.0
		Iris, 1979	14,432					39.2
		Jujo, 1980	17,548					32.0
		Caparroso, 1982	18,368					41.2
		Tecominoacan, 1983	19,519					37.5
		Jolote, 1983	18,119					39.4
		Artesa Terc., 1984	...					28.0
		Carmito, 1980	10,050					45.6
		Edén, 1983	17,590					38.5
		Samaria Terc., 1965	4,920					13.9
	MARINE ZONE	● Cantarell, 1976	8,528			1,741,800		21.3
	GULF OF CAMPECHE	● Abkatun, 1978	11,800					30.0
		● Ku, 1979	10,000					22.0
		● Pol, 1979	12,600					35.0
		● Chuc, 1982	13,100					35.0
		● Ixtoc, 1984	...					35.0
		Total México		**4,740**	**4,740**	**2,513,300**	**16,547,594,500**	
MOROCCO(e)		Essaouira	...	4	4	270	16,365,350	...
		Rharb, 1951	4,590	1	1			...
		Total Morocco		**5**	**5**	**270**	**16,365,350**	
MYANMAR(e)	**MYANMA**	Chauk-Lanywa, 1902	1,500- 4,000	450	450	12,000	499,555,000	36.0
		Mann, 1970	1,600- 7,000					37.5
		Myanaung, 1964	2,000- 4,000					40.5
		Prome, 1965	850- 5,000					36.0
		Yenangyaung, 1902	100- 6,700					36.0
		Total Myanmar		**450**	**450**	**12,000**	**499,555,000**	
NETHERLANDS	**UNOCAL**	● Haven, 1980	5,300	2	2	2,746	167,484	25.5
		● Helder, 1980	4,800	11	13	5,778	21,637,264	21.6
		● Helm, 1979	4,400	9	9	1,692	8,245,485	17.9
		● Hoorn, 1981	5,000	7	8	4,564	20,943,359	25.8
	NAM	Berkel, 1954	...	17	17	2,417	6,720,000	32.1
		DeLier, 1955	5,200	22	33	472	17,120,000	33.2
		Ijeselmonde, 1956	...	59	86	4,468	92,416,000	26.8
		Pernis West, 1987	...	...	...	...	38,000	28.2
		Plinacker, 1955	...	4	5	421	6,340,000	36.3
		Rotterdam, 1984	...	2	2	3,946	3,719,000	30.5
		Schoonebeek, 1944	2,500	...	495	...	238,327,000	12.3
		Wassenaar, 1956	4,200	...	41	...	46,977,000	18.7
		Werkendam, 1956	...	...	...	...	252,000	33.0
		Zoetermeer, 1957	3,200	30	30	795	10,332,000	16.5
	CONOCO	● Kotter, 1980	6,500	8	11	15,729	37,215,459	33.0
		● Logger, 1982	6,500	6	9	9,913	16,012,118	33.5
	AMOCO	● Rijn, 1982	6,600	12	25	7,077	17,198,048	35.0
		Total Netherlands		**188**	**786**	**60,018**	**543,662,217**	

PRODUCTION

		Name of field, discovery date	Depth, ft	No. of wells Producing	No. of wells Total	Production 1989 average B/d	Production Cumulative to Dec. 31, 1989 Bbl	°API gravity
NEUTRAL ZONE	AOC	● Hout, 1969	5,300-10,500	21	34	32,881	292,130,916	33.0
		● Khafji, 1961	4,400-10,300	136	165	232,777	2,526,521,038	28.2
	TEXACO & KOC[e]	S. Fuwaris, 1963	6,300	5	9			[illegible]
		S. Umm Gudair, 1966	8,900	16	17	131,342	1,783,940,000	24.3
		Wafra, 1953	1,100- 7,000	322	427			18.9-23.5
		Total Neutral Zone		**500**	**652**	**397,000**	**4,602,591,954**	
NEW ZEALAND	SHELL-BP-TODD	● Kapuni, 1959	11,700	11	14	6,100	41,520,000	54.0
		● Maui, 1969	11,000	14	14	15,000	34,200,000	51.0
	PCNZ	Ahuroa, 1987	8,688	...	1	...	9,800	46.1
		Kaimiro, 1982	11,900	2	2	74	145,000	42.0
		McKee, 1980	7,848- 8,251	19	22	11,000	17,680,000	38.5
		Tariki, 1986	9,065	...	1	...	1,500	52.7
		Waihapa, 1988	10,125-10,643	5	6	6,100	3,300,000	36.6
		Total New Zealand		**51**	**60**	**38,274**	**96,856,300**	
NIGERIA	AGIP	Agwe, 1975	10,800	1	1	110	2,042,504	47.9
		Akri, 1967	9,600-10,600	3	11	1,862	60,056,817	40.1
		Akri West, 1972	9,900-10,200	...	2	...	482,258	31.4
		Ashaka, 1968	9,700-12,000	1	1	1,145	2,762,447	38.4
		● Beniboye N., 1978	9,000-10,000	9	9	8,904	11,572,397	29.6
		Beniku, 1974	12,000	...	2	...	3,309,326	29.5
		Clough Creek, 1977	10,000-12,400	7	9	7,439	22,460,507	29.3
		Ebegoro, 1976	11,500-12,000	7	9	7,509	62,109,913	35.7
		Ebocha, 1965	8,000-10,900	8	16	6,959	110,337,245	35.5
		Idu, 1973	7,750-10,730	...	10	...	13,862,581	28.0
		Kwale, 1967	10,000-11,500	8	10	7,667	7,500,675	36.4
		M'Bede, 1966	7,300- 9,400	10	20	14,132	163,238,542	40.9
		Obama, 1973	11,600-14,300	6	8	14,577	97,780,167	37.2
		Obiafu, 1967	9,300-12,200	18	20	15,815	85,766,070	42.4
		Obrikom, 1973	8,000-10,000	6	13	3,371	55,040,901	45.1
		Odugri, 1972	12,500	2	2	634	9,788,065	47.2
		Ogbogene, 1972	10,000	...	2	...	3,302,763	73.0
		Ogbogene W., 1982	13,000	...	1	...	353,196	56.2
		Okpai, 1968	10,000-12,000	8	8	4,779	19,031,162	44.6
		Omoku W., 1975	11,500	...	1	...	4,746,492	27.4
		Oshi, 1972	9,600-11,300	10	11	9,890	66,552,033	34.1
		Taylor Creek, 1975	14,100	1	1	469	473,058	37.7
		Tebidaba, 1975	10,300-13,300	7	10	17,017	118,463,094	33.0
		Umuoru, 1975	14,100	3	4	2,477	5,353,184	40.0
	ASHLAND	● Adanga, 1980	10,611-17,586	9	9	12,953	15,386,228	35.0
		● Akam, 1980	6,700	10	10	7,561	5,802,362	35.2
		● Bogi, 1989	8,256	3	4	1,466	563,367	23.4
		● Ebughu, 1983	7,250	3	3	457	167,263	21.0
		● Izombe-Ossu, 1974	9,500	8	8	13,262	10,645,430	35.0
		● Mimbo, 1989	7,973	4	5	1,967	554,146	36.0
		● Ukpam, 1989	7,425	1	2	2,474	945,474	40.9
	ELF	Aghigo, 1972	7,303	17	29	4,446	24,405,554	24.8
		Erema, 1972	11,211	4	5	4,715	10,847,810	24.6
		Obagi, 1964	8,377	61	68	48,743	368,074,953	24.6
		Obodo-Jatumi, 1966	...	16	18	16,116	69,115,408	24.8
		Okpoko, 1967	6,745	16	17	7,304	32,326,957	24.8
		Upomami, 1965	6,256	14	14	3,600	16,898,167	24.8
	GULF NIGERIA	Abiteye, 1970	5,750- 9,400	10	19	5,294	64,007,793	39.7
		● Delta, 1965	5,600- 9,500	20	27	18,566	169,822,039	37.3
		● Delta South, 1965	7,100-10,179	18	28	31,483	269,735,952	38.4
		● Isan, 1970	5,900- 9,000	6	11	2,369	42,897,085	40.4
		Jisike, 1975	6,300- 7,600	1	4	1,589	6,338,968	41.1
		Makaraba	7,100-12,005	20	25	20,819	92,637,107	[illegible]
		● Malu, 1969	4,800- 6,300	12	19	16,371	102,394,051	40.4
		● Mefa, 1965	8,570-12,030	5	5	5,832	67,968,348	38.1
		● Meji, 1965	5,200-10,900	19	22	18,979	151,312,520	31.9
		● Meren, 1965	5,000- 7,500	31	55	57,685	493,040,316	31.9
		● Mina	...	3	3	6,161	2,248,843	40.3
		● Okan, 1964	5,500- 9,245	35	71	33,485	390,246,940	38.1
		● Parabe/Eko, 1968	4,500- 8,200	13	26	10,783	103,215,846	40.4
		Robertkiri, 1964	11,484-13,190	10	12	10,403	12,516,783	40.2
		● Tapa, 1978	8,150-10,842	8	10	9,233	28,142,426	39.5
		Utonana, 1971	7,400- 9,165	1	5	816	8,165,121	20.4
		● W. Isan, 1971	7,825-10,229	5	9	2,011	34,745,318	40.4
		Yorla South, 1974	11,389-12,635	...	2	...	834,040	41.0
	MOBIL	● Adua, 1967	6,970	5	5	10,758	46,537,232	30.3
		● Asabo, 1966	5,600	9	14	15,175	161,113,170	32.4
		● Asabo D	...	1	2	1,241	2,250,081	35.0
		● Ata	...	...	...	...	433	...
		Edop	8,528- 9,901	3	4	21,558	8,394,906	37.7
		● Ekpe, 1966	8,200	8	17	9,613	188,394,905	30.3
		● Ekpe-WW, 1977	6,810	5	6	7,449	190,3325,525	30.3

	Name of field, discovery date	Depth, ft	No. of wells Producing	 Total	Production 1989 average B/d	 Cumulative to Dec. 31, 1989 Bbl	°API gravity
	• Eku, 1966	5,420	3	7	3,178	15,955,736	30.8
	• Enang, 1968	6,600	18	23	23,127	35,960,995	35.1
	• Etim, 1968	6,200	7	9	16,989	112,511,703	32.9
	• Idoho, 1966	9,020	3	4	1,017	28,842,611	30.8
	• Inim, 1966	5,850	7	10	14,963	145,437,397	37.8
	• Isobo, 1968	7,345	3	5	3,263	8,180,634	30.8
	• Iyak SE	7,441	6	5	16,155	40,682,165	38.7
	• Mfem, 1967	5,200	2	4	4,185	25,627,206	36.1
	• Oso	...	...	...	...	...	...
	• Ubit, 1968	5,400	30	45	25,322	185,674,618	36.1
	• Unam, 1968	5,180	7	8	9,744	43,881,190	33.5
	• Usari	...	...	...	...	5,885	...
	• Utue, 1966	5,700	5	7	8,653	70,170,645	36.8
PAN OCEAN (NIGERIA)	Ogharefe, 1973	9,900	7	7	2,764	9,890,444	47.4
SHELL	Abura	...	1	3	...	17,247,935	44.6
	Afremo	...	9	9	18,992	12,036,226	36.9
	Ahia	...	8	13	4,171	86,874,306	39.4
	Akaso		...	1	...	...	...
	Akpor	...	...	3	...	...	27.5
	Alakiri	9,625-10,712	12	21	7,248	68,233,759	44.7
	Amukpe	...	2	2	1,853	13,154,765	41.1
	Assa	...	2	2	1,051	5,562,686	20.16
	Bugama Creek	...	5	7	1,366	13,312,766	36.8
	Cesw-Adibawa, 1967	11,950	12	23	16,383	82,548,600	26.2
	Cesw-Adibawa NE, 1973	...	3	3	6,175	17,107,947	27.5
	Cesw-Diebu Creek, 1966	13,119	4	8	10,620	108,910,459	40.8
	Cesw-Etelebou, 1971	12,000	9	9	15,746	126,903,233	31.0
	Cesw-Kolo Creek, 1960	12,000	15	25	20,023	136,712,922	39.4
	Cesw-Nun River, 1960	14,200	4	6	2,098	32,772,212	33.7
	Cesw-Ubie, 1961	14,380	5	6	4,755	33,017,108	26.7
	Cosw-Nembe Creek, 1973	12,213	35	36	86,744	249,866,511	30.6
	Eade-Opobo South, 1974	...	4	6	4,109	20,268,510	43.1
	Eade-Utapate South, 1974	...	6	8	6,418	39,304,491	39.0
	Ebubu	...	2	8	157	18,808,065	19.8
	Egb-Oguta, 1965	10,300	8	11	6,346	132,487,741	43.9
	Egbema	...	6	7	4,306	55,381,361	34.8
	Egbema West	...	5	7	4,622	81,832,450	41.1
	Enwhe	...	...	2	...	...	...
	Forc-Ajuju, 1970	13,324	1	2	...	...	27.0
	Forc-Batan, 1968	11,000	7	8	6,285	57,482,932	21.3
	Forc-Benisede, 1973	...	11	14	31,089	114,511,463	22.0
	Forc-Egwa, 1967	9,350	17	19	18,337	140,603,754	33.4
	Forc-Escravos Beach, 1969	8,176	7	8	10,140	61,920,984	30.4
	Forc-Forcados/Yokri, 1968	10,859	51	52	69,810	571,116,961	24.4
	Forc-Jones Creek, 1967	7,000- 9,000	24	26	44,199	410,217,843	29.8
	Forc-Odidi, 1967	10,980	25	28	43,942	222,326,504	36.4
	Forc-Opuama, 1973	...	2	2	2,734	26,496,113	42.4
	Forc-Opukushi, 1963	7,823	9	10	26,104	124,368,680	28.4
	Forc-Opukushi N., 1977	...	1	2	556	2,791,314	24.7
	Forc-Otumara, 1969	8,176	21	25	41,532	171,485,364	24.9
	Forc-Saghara, 1970	8,590	5	6	7,858	34,812,316	31.9
	Ibigwe	...	1	2	...	...	...
	Kalaekule	...	6	7	13,090	8,932,181	40.3
	Korokoro	...	6	8	2,703	84,303,645	36.0
	Krakama	...	3	10	1,662	18,049,647	22.8
	Node-Oben, 1972	12,036	14	23	19,935	128,437,854	37.5
	Node-Sapele, 1970	12,788	10	11	13,982	118,226,990	43.1
	Obele	...	...	5	...	...	...
	Odeama Creek	...	4	5	20,847	28,171,077	35.4
	Osioka	...	1	2	786	7,502,989	26.2
	Otamini	...	2	2	1,649	14,564,408	20.8
	Phl-Afam, 1956	6,000	9	9	2,240	60,521,763	45.2
	Phl-Agbada, 1960	8,000-12,000	30	31	20,718	188,963,520	24.4
	Phl-Ajokpori, 1967	...	1	2	453	5,654,946	39.0
	Phl-Akuba, 1967	...	1	1	402	4,392,385	22.7
	Phl-Apara, 1960	9,000	4	4	4,935	27,913,330	38.3
	Phl-Bodo-West, 1959	9,700	9	9	4,919	82,443,920	26.5
	Phl-Bomu, 1958	6,500- 7,500	9	11	7,574	357,197,222	36.8
	Phl-Elelenwa, 1959	11,000	5	6	3,684	33,750,837	35.3
	Phl-Imo River, 1959	5,800-10,000	37	40	37,788	481,411,176	31.0
	Phl-Isimiri, 1964	5,900-11,000	1	3	1,617	38,228,064	26.0
	Phl-Nkali, 1963	12,000	3	3	3,848	30,539,652	39.3
	Phl-Obeakpu, 1975	...	2	2	3,098	18,230,182	26.4
	Phl-Obigbo-North, 1963	6,500-10,000	23	23	12,329	178,774,185	23.3
	Phl-Onne, 1965	10,384	3	3	1,210	9,804,577	34.3
	Phl-Umuechem, 1969	5,800-10,700	8	10	4,495	149,809,342	35.6
	Phl-Yorla, 1970	11,917	4	7	4,367	61,810,385	39.6
	Phs-Akaso, 1979	...	1	1	1,486	3,770,294	36.0
	Phs-Bonny, 1959	12,254	8	8	5,260	91,565,141	31.8
	Phs-Cawthorne Channel, 1963	11,000	19	21	44,904	297,078,967	38.3
	Phs-Ekulama, 1958	10,483	20	20	37,116	215,051,740	32.0
	Phs-Orubiri, 1971	...	1	2	2,933	18,120,944	37.98

				No. of wells		Production		
		Name of field, discovery date	Depth, ft	Producing	Total	1989 average B/d	Cumulative to Dec. 31, 1989 Bbl	°API gravity
		Phs-Soku, 1958	11,500	17	23	10,985	115,359,210	28.0
		Rapele	...	1	3	489	23,012,074	44.4
		Rumuekpe	...	2	3	2,217	1,829,155	29.3
		Tai	...	1	2	554	4,887,832	38.1
		Ugada	...	1	1	...	...	...
		Ugh-Afiesere, 1966	8,000- 9,000	23	27	10,466	121,140,595	18.9
		Ugh-Eriemu, 1961	12,500	12	14	5,480	45,696,354	20.1
		Ugh-Evwreni, 1968	10,900	8	9	3,497	37,874,976	25.2
		Ugh-Isoko, 1960	...	1	2	765	6,234,074	30.3
		Ugh-Kokori, 1960	8,000- 9,800	7	8	10,061	315,106,094	45.2
		Ugh-Ogini, 1964	5,860	4	5	2,944	23,389,308	18.7
		Ugh-Olomoro, 1963	7,000-10,000	16	22	15,234	286,297,772	21.4
		Ugh-Oroni, 1964	12,000	4	5	2,031	26,716,637	22.4
		Ugh-Oweh, 1964	12,300	9	9	5,841	96,495,512	26.2
		Ugh-Ughelli-East, 1959	11,800	7	7	2,571	90,512,168	38.6
		Ugh-Ughelli-West, 1963	7,400-10,200	7	9	5,483	35,202,936	20.4
		Ugh-Utorogu, 1964	9,000	16	16	7,246	133,198,137	28.3
		Ugh-Uzere-East, 1960	8,500	11	11	6,497	90,364,319	33.9
		Ugh-Uzere-West, 1964	8,500	10	10	5,723	101,566,708	24.2
		Ugh-Warri-River, 1961	12,264	1	2	795	15,366,811	29.4
	TEXACO-CHEVRON-NNPC	● Funiwa, 1978	5,000- 7,000	20	22	22,177	43,904,868	38.2
		● Middleton, 1972	5,000- 7,000	3	7	2,363	15,813,022	36.6
		● North Apoi, 1973	4,000- 8,100	22	26	[illegible]3,776	162,994,363	35.8
		● Pennington, 1965	5,000-10,400	1	10	2,000	35,109,345	38.2
		● Sengana, 1967	11,400-12,500	...	2	...	666,120	46.7
	TENNECO	Abura	13,452	1	...	1,451	17,247,935	44.6
	AGIP ENERGY	Agbara, 1988	10,699	16	16	9,500	2,365,648	42.5
	DUBRI	Gilli-Gilli	...	1	...	981	8,074,119	46.9
		Total Nigeria		**1,432**	**1,898**	**1,673,809**	**12,752,358,229**	
NORWAY	**AMOCO**	● Valhall, 1972	8,200	22	22	73,092	129,725,993	35.0
	BP	● Ula, 1976	10,100	6	13	88,037	98,724,867	38.8
	CONOCO	● Murchison*, 1975	9,900	18	30	8,160	57,716,337	38.0
	NORSK HYDRO	● Oseberg, 1979	7,500	8	12	233,003	85,046,019	34.0
	PHILLIPS	● Albuskjell, 1972	10,400	13	19	2,447	42,162,601	45.0
		● Cod, 1968	9,500	6	8	1,191	15,659,706	55.0
		● Edda, 1972	10,480-10,600	7	7	2,948	22,722,952	41.5
		● Ekofisk, 1968	10,000	41	44	112,782	931,408,127	41.1
		● Eldfisk, 1970	9,350-10,000	37	39	76,978	262,167,186	41.1
		● Tor, 1970	10,000	12	13	8,703	110,437,189	38.0
		● West Ekofisk, 1970	10,300	9	14	3,717	71,550,961	43.9
	STATOIL	● Gullfaks, 1978	9,500- 9,700	63	95	267,000	181,100,000	9.3
		● Statfjord†, 1974	9,500	59	93	585,790	1,455,195,549	38.2
		● Tommeliten, 1976	10,400	5	6	13,534	4,939,866	47.0
		● Veslefrikk, 1981	10,100	12	18	...	...	...
		Total Norway		**318**	**433**	**1,477,382**	**3,468,557,353**	
OMAN	**PDO**	Al Burj, 1987	6,890	6	7	850	2,288,000	28.6
		Al Ghubar, 1974	1,916	3	6	5,300	6,842,000	28.4
		Al Huwaisah, 1969	5,320	43	47	16,500	177,091,000	37.1
		Amal/Amal South, 1973	4,638	34	39	11,900	15,974,000	24.0
		Anzauz, 1984	7,098	4	4	4,600	8,088,000	46.0
		Bahja, 1984	5,697	10	12	12,100	12,822,000	48.9
		Barik, 1974	8,856	3	3	2,300	3,190,000	47.8
		Birba, 1978	8,528	...	...	1,446	8,394,000	30.5
		Burhaan, 1984	4,011	2	4	900	1,981,000	36.9
		Dhiab, 1985	5,414	6	6	900	955,000	25.7
		Fahud, 1964	2,499	153	235	56,000	794,423,000	32.5
		Fayyadh, 1983	3,608	1	1	6,300	706,000	27.5
		Ghaba North, 1972	2,227	14	25	6,000	54,850,000	34.5
		Habur, 1975	5,800	1	2	250	4,481,000	15.6
		Hasirah, 1984	8,708	10	12	9,100	7,339,000	49.8
		Ishan, 1984	5,578	5	6	1,800	1,335,000	28.6
		Jalmud, 1979	4,236	3	3	270	467,000	22.5
		Jalmud North, 1980	4,265	2	2	270	351,000	22.5
		Jameel, 1984	5,906	4	5	1,500	1,025,000	28.6
		Jawdah, 1984	3,570	6	7	1,800	2,385,000	22.5
		Karim West, 1982	3,546	26	27	12,200	18,531,000	23.1
		Kaukab, 1983	8,282	1	1	700	1,401,000	31.9
		Lekhwair, 1968	4,352	47	63	26,200	75,262,000	38.6
		Mahjour, 1979	11,700	1	3	600	2,461,000	47.5
		Marmul, 1977	5,087	169	185	34,100	137,075,000	22.3
		Mawhoob, 1985	6,562	1	1	40	95,400	28.6
		Mukhaizna, 1975	3,478	...	...	...	12,400	15.0
		Natih, 1963	4,788	36	68	24,700	360,400,000	31.2
		Nimr, 1980	3,296	117	119	36,000	37,844,000	21.3

*Norway share (22.2%) of total production. †Norway share (84.09%) of total production.

				No. of wells		Production		
		Name of field, discovery date	Depth, ft	Producing	Total	1989 average B/d	Cumulative to Dec. 31, 1989 Bbl	°API gravity
		Qaharir, 1978	4,536	27	32	7,400	26,432,000	30.4
		Qaharir East, 1978	4,936	2	4	150	791,000	30.4
		Qarn Alam, 1972	1,354	4	7	900	19,665,000	15.6
		Qata, 1979	4,707	11	16	2,100	5,023,000	28.6
		Rahab, 1977	3,237	21	28	2,900	7,523,000	25.7
		Ramlat Rawl, 1987	2,720	1	1	2,500	1,039,000	39.7
		Rasha, 1982	4,310	4	5	700	1,560,000	32.9
		Rima, 1979	3,247	47	48	65,500	153,293,000	32.9
		Runib, 1978	3,215	10	10	2,300	2,651,000	20.3
		Saih Nihaydah, 1972	8,700	21	28	30,000	168,580,000	39.4
		Saih Rawl, 1973	9,826	14	24	7,500	93,702,000	39.7
		Sayyala, 1981	3,690	14	14	22,700	38,483,000	47.8
		Shibkah, 1976	2,591	...	2	40	835,000	31.2
		Simsim, 1985	5,250	11	12	5,000	4,817,000	28.1
		Suwaihat, 1982	6,452	10	10	10,600	15,640,000	41.5
		Thuleilat, 1986	3,773	14	15	3,300	3,096,000	23.8
		Wafra, 1983	5,510	7	8	5,100	3,791,000	36.5
		Warad, 1985	4,922	5	5	1,600	1,256,000	29.3
		Yibal, 1962	8,465	194	206	149,100	722,333,000	37.9
		Zahra, 1986	6,562	5	5	1,100	839,000	29.3
		Zareef, 1985	3,264	10	11	12,000	10,405,000	47.3
		Zauliyah, 1981	8,177	10	14	5,400	14,879,000	46.9
	OCCIDENTAL	Safah, 1983	6,500	81	81	22,300	15,795,000	42.0
	ELF GROUP	Ramlat	...	1	1	80	148,000	46.0
		Sahmah, 1978	12,400	8	8	5,300	26,480,000	46.0
		Total Oman		**1,240**	**1,488**	**640,196**	**3,077,124,800**	
PAKISTAN	**PAKISTAN OILFIELD LTD.**	Balkassar, 1946	9,398	4	17	589	31,903,730	26.0
		Dhulian, 1936	8,899	12	49	24	41,332,384	48.0
		Meyal, 1968	12,513	6	6	2,913	31,923,697	41.3
		Joya Mair, 1944	6,900	2	4	411	6,069,324	15.0
		Khaur, 1915	9,306	13	397	19	4 177,167	33.0
	PAKISTAN PETROLEUM LTD.	Adhi, 1978	9,452- 9,613	5	5	398	1,467,721	51.0
	OGDC	Bobi, 1988	9,515- 7,897	3	3	611	223,085	52.0
		Chak-Naurang, 1986	9,187	3	4	...	322,508	12.1
		Fimkassar, 1982	11,465	1	1	425	190,952	29.4
		Ghotana, 1986	7,300	1	1	...	103,902	41.1
		Lashari Centre, 1988	6,916	1	1	1,763	682,185	44.2
		Pasahki, 1989	7,153	1	1	202	77,257	43.0
		Sono, 1988	7,618	3	4	1,758	1,045,318	40.5
		Tando Alam, 1984	6,890- 7,448	4	10	2,472	6,429,984	41.7
		Thora, 1987	7,546	5	5	4,091	2,612,488	42.2
		Toot, 1968	15,135	5	14	1,153	10,325,565	39.0
	INION TEXAS	Dabhi, 1984	5,594	2	4	1,045	2,210,000	42.0
		Khaskeli, 1981	3,387	4	11	999	7,421,232	38.0
		Laghari, 1983	2,584	4	7	5,409	13,944,754	42.0
		Mazari, 1985	3,888	5	5	6,141	6,946,062	43.0
		South Mazari, 1985	3,920	2	4	2,463	899,021	43.0
		Other	...	7	8	549	200,230	31.0-46.0
	OCCIDENTAL	Bhangali, 1989	12,650	1	1	2,240	206,040	32.5
		Dhurnal, 1984	13,100	4	6	17,169	28,573,996	38.0
		Total Pakistan		**98**	**568**	**52,844**	**199,288,602**	
PERU	**PETROMAR S.A.**	● Litoral, 1955	1,500- 6,000	103	134	2,205	38,155,610	36.0-40.0
		● Lobitos, 1960	3,500- 7,500	140	268	6,672	54,791,522	38.0
		● Pena Negra, 1960	3,000- 8,500	183	304	9,876	112,559,041	38.0
		● Providencia, 1967	3,000- 7,000	47	92	1,716	21,882,501	38.0-40.0
		Other	...	4	12	98	291 705	...
	OCCIDENTAL	Bartra, 1979	8,000- 8,930	7	16	2,883	19,215,565	11.6
		Capahuari Sur, 1973	11,800-12,900	14	21	7,722	134,808,739	33.7
		Dorissa, 1978	9,800-10,600	4	13	6,175	39,421,977	32.0
		Forestal, 1973	9,000- 9,900	6	12	4,928	36,696,670	18.5
		Huayuri Sur, 1977	10,000-10,800	5	12	2,561	19,505,497	28.5
		Jibarito, 1981	9,000- 9,650	4	5	4,737	13,186,861	10.5
		Jibaro, 1974	10,110-10,155	4	6	2,306	8,330,884	10.6
		San Jacinto, 1978	7,200- 9,760	11	22	5,859	31,091,167	14.9
		Shiviyacu, 1973	9,100-10,100	18	26	17,909	71,596,811	20.3
		Other	...	3	12	701	2,307,545	21.3
	OCCIDENTAL/BRIDAS	Talara area, 1978	1,343- 6,080	757	1,244	5,647	48,614,022	34.8
	PETROPERU	Capirona, 1972	9,800-12,000	3	5	556	3,742,954	25.0
		Corrientes, 1971	10,000-12,600	28	36	19,375	101,536,099	24.9
		N. Esperanza, 1980	10,200-10,700	2	3	1,920	5,570,559	42.5
		Pavayacu, 1972	9,600-11,300	9	14	2,665	17,458,776	29.5
		Selva Central	...	36	46	2,633	27,362,437	36.0
		Talara-Lima area, 1869	2,000- 9,000	2,142	6,117	21,789	961,984,018	32.3
		Valencia, 1975	10,500-11,200	1	2	30	546,548	43.0
		Yanayacu, 1974	11,400-13,600	5	9	1,080	4,505,374	18.8
		Total Peru		**3,536**	**8,431**	**132,043**	**1,775,162,882**	

				No. of wells		Production		
		Name of field, discovery date	Depth, ft	Producing	Total	1989 average B/d	Cumulative to Dec. 31, 1989 Bbl	°API gravity
PHILIPPINES	**ALCORN PHILIPPINES**	● Galoc, 1981	7,260- 7,280	...	...	...	383,460	37.2
		● Matinloc, 1978	6,656- 6,750	3	5	1,141	9,864,707	43.8
		● Nido, 1977	6,576- 6,885	3	5	709	16,056,500	27.1
		● North Matinloc, 1987	6,830- 7,021	3	3	1,652	922,917	43.2
	ALCORN PALAWAN	● Cadlao, 1977	5,734- 5,881	2	2	1,445	10,446,633	45.6
	TRANS-ASIA OIL & MINERAL DEVELOPMENT CORP.	● South Tara, 1987	4,335- 4,436	1	1	198	218,251	40.4
		Total Philippines		**12**	**16**	**5,145**	**37,892,468**	
QATAR(e)	**QGPC**	● Bul Hanine, 1970	6,000	14	15			35.0
		Dukhan, 1940	6,500	116	161			41.1
		● Idd El Shargi, 1960	4,500- 8,250	25	31	387,000	4,312,876,000	35.0
		● Maydan Mahzam, 1963	7,000	19	24			38.0
		Total Qatar		**174**	**231**	**387,000**	**4,312,876,000**	
RAS al KHAIMAH(e)	**CHEVRON**	● Saleh, 1983	14,500	6	6	10,000	20,141,000	50.0
		Total Ras al Khaimah		**6**	**6**	**10,000**	**20,141,000**	
SAUDI ARABIA(e)	**ARAMCO**	Abqaiq, 1940	6,690					37.0
		Abu-Hadriya, 1940	9,340					35.0
		Abu Jiffan	...					...
		● Abu-Safah, 1963	6,600					30.0
		Bakr	...					...
		● Berri, 1964	8,300					32.0-34.0
		Dammam, 1938	4,800					35.0
		Dhib	...					...
		Dibdibah	...					...
		Duhul	...					...
		El Haba	...					...
		Fadhili, 1949	8,050					39.0
		Farhah	...					...
		Faridah	...					...
		Ghawar, 1948	6,920					34.0
		Habari	...					...
		● Hamur	...					...
		Harmaliyah, 1971	8,430					35.0
		● Harqus	...					...
		● Hasbah	...					...
		Jaham	...					...
		Jaladi	...					...
		● Jana	...					...
		Jauf	...	858	858	4,995,000	57,780,625,000	...
		Jawb	...					...
		Juraybi'at	...					...
		● Jurayd	...					...
		● Karan	...					...
		Khurais, 1957	5,200					33.0
		Khursaniyah, 1956	6,560					31.0
		● Kurayn	...					...
		● Lawhah	...					...
		Lughfah	...					...
		● Maharah	...					...
		● Manifa, 1957	7,950					...
		● Marjan, 1967	6,800					33.0
		Mazalij	...					...
		Qatif, 1945	7,100					33.0-34.0
		Qirdi	...					...
		● Ribyan	...					...
		Rimthan	...					...
		● Safaniya, 1951	5,100					27.0
		Sahba	...					...
		Samin	..					...
		Sharar	...					...
		Suban	...					...
		Tinat	...					...
		Wari'ah	...					...
		Watban	...					...
		● Zuluf, 1965	5,800					32.0
		Total Saudi Arabia		**858**	**858**	**4,995,000**	**57,780,625,000**	
SHARJAH	**AMOCO**	Saaja and Moveyid, 1980	10,200-12,300	16	16	28,114	114,661,700	50.0
	CRESCENT(e)	● Mubarek,(c) 1972	...	4	4	6,886	99,450,000	37.0
		Total Sharjah		**20**	**20**	**35,000**	**214,111,700**	
SPAIN	**SHELL ESPANA**	● Amposta Marino Norte, 1970	10,000	...	8	...	55,667,000	37.0
		● Tarraco (Castellon B5 8), 1973	9,000	..	3	...	14,547,000	35.0
	CHEVRON	Ayoluengo, 1964	4,600- 5,200	34	42	750	15,379,025	37.0

WORLDWIDE PRODUCTION

		Name of field, discovery date	Depth, ft	No. of wells		Production		°API gravity
				Producing	Total	1989 average B/d	Cumulative to Dec. 31, 1989 Bbl	
	REPSOL	● Casablanca, 1975	8,900	7	9	17,531	95,422,194	33.0
		● Gaviota,(c) 1980	8,300	3	3	2,840	2,267,315	52.7
		● Angula, 1984	12,600	...	1	...	17,843,906	44.0
		● Dorada, 1975	6,700	...	4	...		21.5
		● Salmonete, 1984	12,600	...	1	...		44.0
		Total Spain		**44**	**71**	**21,121**	**201,126,440**	
SURINAME	STAATSOLIE	Tambaredjo, 1981	1,040	124	124	3,800	4,861,700	15.9
		Total Suriname		**124**	**124**	**3,800**	**4,861,700**	
SYRIA	AL FURAT OIL CO. (SHELL)	Al Ishara East, 1986	...	...	...	7,945	5,400,000	38.1
		Ash Shola, 1985	...	...	...	...	220,000	37.0
		El Ahwar, 1986	...	...	...	5,479	4,500,000	34.0
		El Wafd North, 1986	...	...	...	21,006	14,500,000	38.1
		Jido, 1986	...	...	...	2,192	2,600,000	33.0
		Thayyem, 1983	...	...		71,233	83,600,000	36.5
	S.P.C.(e)	Alian, 1974	5,900	25	37	232,055	1,141,495,075	19.0
		Gbebeh, 1976	2,300	54	75			18.0
		Jebisseh, 1968	2,000- 3,300	132	219			18.0
		Karachok, 1956	6,500	103	119			20.0
		Rumilan, 1962	6,500	59	66			24.0
		Soudie, 1959	6,500	532	579			24.0
		Tichrine, 1976	2,600	58	73			18.0
		Total Syria		**963**	**1,168**	**340,000**	**1,252,315,075**	
THAILAND	UNOCAL	● Baanpot,(c) 1980	7,000	22	30	1,863	2,698,500	54.0
		● Erawan,(c) 1973	7,000	93	155	7,325	19,410,200	54.6
		● Kaphong,(c) 1974	8,000	23	24	2,406	368,100	55.0
		● Platong,(c) 1976	8,500	26	49	2,885	6,576,200	59.1
		● Satun,(c) 1980	8,500	64	67	5,409	7,984,800	55.1
	THAI SHELL	Pru Krathiam, 1984	4,200	1	1	20	25,700	19.0
		Sirikit, 1981	5,258- 5,976	54	85	19,475	40,744,400	41.0
		Sirikit West, 1983	5,500	2	2	116	630,300	41.0
		Thap Raet, 1989	11,100	1	1	537	66,000	41.0
		Wat Taen, 1988	7,790	1	1	108	81,500	37.0-40.0
		Total Thailand		**287**	**415**	**40,144**	**78,585,700**	
TRINIDAD	TRINIDAD & TOBAGO OIL CO. LTD. (TRINTOC)	Area IV and Guapo, 1963		85	192	1,265	39,598,000	...
		Barrackpore, 1911	11,100	83	379	3,762	33,301,000	...
		Brighton, 1903	7,500	59	620	548	70,674,000	...
		Catshill, 1950	9,693	31	134	300	23,252,000	...
		Forest Reserve, 1913	11,000	289	2,042	3,738	261,724,000	...
		Grand Ravine,* 1929	11,000	51	168	594	27,077,000	...
		Guayaguayare, 1902	10,750	115	699	1,944	87,963,000	...
		Oropouche, 1944	9,100	29	128	146	6,764,000	...
		Palo Seco, 1929	12,700	77	939	1,652	94,484,000	...
		Parrylands 1-5, 1913	10,626	118	508	1,526	41,268,000	...
		Penal, 1936	11,067	78	289	982	62,763,000	...
		Point Fortin C & W, 1907	10,626	124	551	1,699	42,047,000	...
		Trinity, 1956	9,700	20	95	240	15,306,000	...
		Other	...	63	813	933	71,817,000	...
	TRINIDAD NORTHERN AREAS (TNA)	● Forun Offshore (FOS), 1954	...	12	35	247	7,185,000	...
		● Soldado, 1955	11,000	371	673	36,679	490,015,000	...
	AMOCO TRINIDAD OIL CO. LTD.	● Cassia, 1973	12,700	9	10	4,439	14,184,000	...
		Mora, 1982	8,500	4	6	427	728,000	...
		● Poui, 1974	11,650	36	58	20,274	164,596,000	...
		● Samaan, 1971	11,780	40	57	15,530	184,737,000	...
		● Teak, 1969	15,191	53	104	31,874	251,133,000	...
	TRINIDAD & TOBAGO PETROLEUM CO. LTD. (TRINTOPEC)	Centarl Los Bajos, 1973	...	162	221	2,509	10,304,000	...
		Coora/Quarry, 1936	14,000	151	736	1,720	92,482,000	...
		Fyzabad/Apex/Quarry, 1920-38	11,000–	300	1,042	3,062	173,046,000	...
		Galeota, 1963	6,304	47	105	2,177	16,893,000	...
		Palo Seco/Erin/McKenzie, 1926	12,718	493	1,581	7,761	122,996,000	...
		Other	...	196	923	2,492	72,239,000	...
	PREMIER CONSOLIDATED OILFIELDS LTD. (P.C.O.L)	All fields	...	103	503	820	21,150,000	...
		Total Trinidad		**3,199**	**13,611**	**149,340**	**2,499,726,000**	...
TUNISIA	ELF-ETAP	● Ashtart	10,500	16	21	28,675	193,045,843	29.8
	ELF-SEREPT	Douleb/Semmama, 1966	3,937	12	15	585	18,155,068	40.0
		Tamesmida, 1967	3,937	3	3	176	2,151,019	36.9
	SHELL	● Tazerka, 1979	...	...	...	...	14,621,000	30.0
	ETAP-AGIP-FINA (SODEPS)	Debbech, 1980	7,500	1	1	27	259,422	42.6
		Larich, 1979	7,550	2	2	117	313,851	40.7
		Makhrouga, 1980-89	6,230	4	4	5,318	7,568,176	45.0

		Name of field, discovery date	Depth, ft	No. of wells Producing	No. of wells Total	Production 1989 average B/d	Production Cumulative to Dec. 31, 1989 Bbl	°API gravity
	AGIP-TUNISIA (SITEP)	Chouech es Saida, 1971	12,600	1	1	455	2,759,065	42.9
		El Borma, 1964	8,250- 8,900	87	113	28,885	420,131,958	42.5
	CFPT[(e)]	Sidi El Itayem, 1971	7,500- 7,800	21	23	38,762	148,143,200	44.0
		Total Tunisia		**147**	**183**	**103,000**	**807,148,602**	
TURKEY	ALADDIN MIDDLE EAST LTD.[(e)]	Kahta, 1958	3,500	12	25	1,993	4,778,472	11.0
		Yasince, 1974	6,400	2	4			31.0
	MOBIL	Bulgurdağ, 1961	4,500	2	2	39	2,495,807	37.2
		Selmo, 1964	5,800	21	21	3,566	68,088,457	34.2
	SHELL	Barbes Deep, 1971	...	18	22	...	50,000	37.2
		Baysu, 1985	...	6	7	1,800	1,160,000	34.5
		Bektas, 1985	...	1	1	380	440,000	34.7
		Beykan, 1964	...	38	48	2,360	60,660,000	33.2
		Cobantepe, 1975	...	—	—	...	218,000	29.5
		Katin, 1971	...	3	8	...	3,730,000	29.7
		Kayako W (OF), 1964	...	19	29	3,100	31,440,000	34.1
		Kayakoy, 1960	...	14	27	1,340	20,200,000	38.2
		Kervan, 1982	...	...	...	...	4,000	30.3
		Kurkan, 1963	...	29	35	1,420	49,620,000	31.4
		Kurkan S, 1965	...	5	10	930	7,240,000	34.5
		Malatepe, 1970	...	14	15	790	7,190,000	32.7
		Piyanko, 1968	...	1	3	...	1,520,000	35.3
		Sahaban, 1965	...	7	13	540	13,440,000	34.5
		Sahaban SE, 1983	...	2	2	190	470,000	34.5
		Sincan, 1979	...	8	9	600	3,320,000	31.4
		Yatir E, 1973	...	9	11	410	5,450,000	30.9
		Yenikoy E, 1974	...	2	2	760	4,570,000	31.3
		Yesildere, 1985	...	3	3	550	597,000	34.5
	TPAO	Adiyaman, 1971	5,800	8	8	508	8,420,930	27.6
		Akpinar, 1964	10,500	4	4	67	157,937	31.6
		Alcik, 1983	6,500	1	1	36	95,486	32.0
		B. Firat, 1986	8,150	11	11	1,137	1,754,761	34.8
		B. Kozluca, 1985	5,000	23	23	933	1,563,510	12.0
		B. Selmo, 1981	5,500	4	4	288	739,096	34.0
		Batı Raman, 1961	4,200	112	112	6,344	37,884,010	13.3
		Beycayir, 1976	7,700	1	1	29	207,804	26.4
		Bölükyayla, 1977	10,300	...	...	...	167,663	35.0
		Camurlu, 1976	5,600	14	14	420	1,186,859	12.2
		Celikli, 1964	10,500	11	11	888	3,821,585	35.2
		Cemberlitas, 1983	6,500	20	20	2,859	8,135,017	30.5
		Cukurtas, 1985	10,000	1	1	23	219,021	36.0
		Devecatak, 1973	4,800	2	2	66	272,735	37.0
		G. Adiyaman, 1977	5,000	...	...	...	115,836	20.4
		G. Dincer, 1981	5,350	15	15	902	4,861,381	16.7
		G. Karakus, 1989	7,900	1	1	265	39,691	26.5
		G. Kayaköy, 1976	8,600	4	4	416	2,347,288	30.4
		G. Sahaban, 1978	5,450	9	9	807	3,234,655	33.2
		G. Saricak, 1973	5,250	12	12	160	4,384,785	31.5
		Garzan, 1956	4,700	24	24	1,147	33,360,976	26.2
		Germik, 1968	6,500	10	10	294	3,508,066	18.3
		Ikiztepe, 1976	4,900	...	...	...	88,051	11.3
		K. Osmancik, 1971	3,800	3	3	230	2,172,980	37.6
		Karakus, 1988	8,850	10	10	8,673	3,236,560	30.0
		Karteltepe, 1982	6,550	3	3	366	1,017,971	32.0
		Kurtalan, 1961	5,750	1	1	26	252,180	31.9
		Kuzey Adiyaman, 1977	9,500	...	...	...	59,375	32.0
		Mağrip, 1961	5,700	11	11	658	15,11,439	18.4
		Mehmetdere, 1982	6,700	...	...	...	157,439	31.0
		Oyuktas, 1972	7,600	...	...	...	592,005	31.0
		Raman, 1940	4,500	80	80	4,583	52,063,105	18.7
		S. Sinan, 1987	3,900	3	3	161	119,003	13.0
		Saricak, 1973	5,250	5	5	221	2,737,116	31.5
		Sezgin, 1970	5,600	...	...	...	87,559	17.0
		Silivanka, 1962	8,200	11	11	808	8,027,847	23.0
		Sivritepe, 1977	8,200	...	...	...	591,789	33.4
		Yeniköy, 1973	6,400	23	23	1,937	9,768,385	31.4
		Total Turkey		**653**	**734**	**56,000**	**499,243,632**	
UNITED KINGDOM	AMOCO	● Montrose, 1969	8,100	13	15	3,640	79,613,099	40.0
		● NW Hutton, 1975	11,200	32	35	17,571	94,920,109	36.0
	ARCO	● Thames,[(c)] 1973	7,892	6	7	148	222,000	48.8
	BP[(e)]	● Beatrice (A & B), 1976	6,750	27	39			38.4
		● Buchan, 1974	8,700	9	9			33.0
		● Clyde, 1978	12,400	10	30			38.1
		● Deveron, 1972	9,000	3	3			38.2
		East Midlands, 1939	3,500	65	132			36.0
		● Forties and Echo, 1970	7,000	79	103			37.0
		Kimmeridge, 1959	1,705	1	1	478,888	2,918,163,942	40.0

	Name of field, discovery date	Depth, ft	No. of wells Producing	No. of wells Total	Production 1989 average B/d	Production Cumulative to Dec. 31, 1989 Bbl	°API gravity
	● Magnus, 1974	9,500	11	11			39.0
	Nettleham, 1983	8,850	1	2			35.0
	Stainton, 1984	5,200	1	3			...
	Scampton, 1985	5,360	...	3			...
	● Thistle, 1973	9,000	33	52			38.0
	Welton, 1981	5,000	...	...			36.0
	Wytch Farm Bridport Sand, 1974	3,031	10	16			37.0
	Wytch Farm Sherwood Sandstone, 1978	5,198	5	5			37.9
CHEVRON	● Ninian, 1974	10,000	69	105	130,426	858,229,932	35.6
CONOCO	● Dunlin, 1973	9,100	26	41	39,408	273,335,000	36.0
	● Hutton, 1973	10,000	16	29	41,253	117,430,506	33.0
	● Murchison*, 1975	9,900	18	30	28,595	202,267,164	38.0
	● Statfjord†, 1974	9,500	59	93	110,833	275,375,974	39.0
HAMILTON BROS. OIL & GAS LTD.	● Argyll, 1971	9,000- 9,400	7	7	5,790	68,230,000	38.0
	● Crawford, 1975	6,900- 8,500	4	4	5,830	2,130,000	30.0
	● Duncan, 1980	9,600-10,000	2	2	1,440	17,980,000	36.0
	● Innes, 1983	12,300-12,600	2	2	1,190	5,440,000	45.0
MARATHON	● Central Brae crude oil, 1976	14,100-15,000	3	3	3,100	1,105,000	33.0
	● North Brae condensate, 1975	11,900-12,475	10	13	69,600	36,603,000	45.0
	● South Brae crude oil, 1975	12,700-13,437	17	27	48,800	213,114,000	35.0
MOBIL	● Beryl, 1972	9,900-11,500	38	48	98,352	427,369,427	37.0
	● Linnhe, 1988	11,500-12,065	1	1	469	171,286	37.8
	● Ness, 1986	9,900-10,112	3	4	13,524	13,164,501	37.0
OCCIDENTAL	● Claymore, 1974	8,100	5	29	4,705	324,709,332	30.1
	● Piper, 1973	8,100	...	...	...	834,416,000	37.0
	● Scapa, 1981	8,100	4	5	11,868	21,287,150	32.0
SHELL	● Auk, 1971	...	9	11	6,301	2,700,000	38.0
	● Brent, 1971	...	53	130	198,630	1,277,400,000	40.0
	● Cormorant, 1972	...	17	37	70,137	324,200,000	36.0
	● Dunlin , 1973	...	26	40	25,565	317,254,000	36.0
	● Eider, 1976	...	...	...	30,904	15,200,000	34.0
	● Fulmar, 1975	...	13	28	117,494	392,145,000	40.0
PHILLIPS	● Maureen, 1973	8,000- 8,700	7	12	48,777	154,878,640	35.9
TEXACO NORTH SEA	● Highlander, 1976	8,759- 9,372	5	7	22,100	40,623,000	34.0
	● Petronella, 1975	8,110	1	1	11,000	10,654,000	40.2
	● Tartan, 1974	10,217-12,614	7	5	16,700	72,157,000	38.0
TOTAL OIL MARINE	● Alwyn North, 1975	...	9	29	90,000	57,301,000	40.0-41.0
UNOCAL	● Heather, 1973	10,800	25	40	11,962	84,180,446	34.3
	Total United Kingdom		**762**	**1,259**	**1,773,000**	**9,613,970,508**	

*U.K. share (77.8%) of total production. †U.K. share (15.91%) of total production.

VENEZUELA

	Name of field, discovery date	Depth, ft	No. of wells Producing	No. of wells Total	Production 1989 average B/d	Production Cumulative to Dec. 31, 1989 Bbl	°API gravity
PDVSA/ ZULIA	Alturitas	...	7	14	1,745	3,346,087	32.2
	Bachaquero, 1930	10,720	1,850	3,709	215,868	6,541,430,236	22.9
	Boscan, 1946	9,708	76	478	19,381	747,254,243	10.2
	Cabimas, 1917	2,200	522	1,234	48,620	1,638,449,492	22.4
	Centro, 1959	9,600-11,000	329	606	135,853	936,775,718	33.6
	Ceuta	16,380	110	179	65,565	477,291,615	30.2
	Cruces-Manueles, 1916	3,000- 8,000	41	133	1,302	177,289,790	30.2
	La Concepcion, 1953	3,148- 8,000	52	162	3,297	138,735,445	30.1
	La Paz, 1925	4,268- 8,000	57	154	10,136	862,352,054	30.1
	Lago, 1959	11,450	30	66	17,501	241,447,842	30.5
	Lagunillas, 1926	3,000	2,609	5,187	346,050	10,954,851,444	22.0
	Lama, 1957	8,320	1,941	1,941	138,246	2,629,778,032	32.2
	Lamar, 1958	13,000	108	186	70,491	1,162,688,577	33.5
	Mara, 1945	5,240	37	105	4,899	415,588,131	26.6
	Mene Grande, 1914	4,130	570	583	953	673,630,970	19.9
	Motatan, 1952	...	27	30	42,977	100,625,197	22.0
	Sibucana, 1948	13,450	...	1	...	43,418,125	...
	Tia Juana, 1928	3,000	1,801	3,079	130,114	4,058,506,604	17.9
	Urdaneta, 1970	10,000	152	283	35,989	152,274,347	22.0
	West-Tarra, 1942	4,250- 5,500	20	44	2,465	74,003,614	30.2
	Other	..	135	408	31,341	2,042,929,176	
PDVSA/ ANZOA-TEGUI	Adjuntas, 1957	5,000	..	54	...	8,714,849	13.9
	Arecuna	1,300	53	118	3,742	10,997,661	11.0
	Bare	1,110	158	275	13,800	25,850,128	10.2
	Caico Seco, 1946	6,500- 7,300	2	8	381	8,981,806	31.8
	Chimire, 1948	7,000- 7,200	50	190	2,655	122,907,767	31.1
	Dacion, 1957	6,700	70	140	7,914	229,438,085	23.0
	El Roble, 1939	3,500-11,500	24	58	2,070	43,107,831	49.3
	El Toco	2,300	27	43	866	15,795,449	23.7
	Elias, 1954	5,000- 6,470	44	220	...	...	...
	Guara, 1946	5,000-10,000	102	221	3,986	249,620,996	27.0
	Guario, 1940	3,400	18	59	743	27,232,886	43.6
	Isla, 1954	...	21	67	4,731	57,938,711	40.5
	La Ceiba, 1946	9,450	22	37	3,381	49,682,318	41.9
	La Ceibita, 1963	9,878	19	47	1,978	83,320,150	42.0
	Leona, 1938	2,200-12,800	16	63	1,222	51,881,445	26.7

		Name of field, discovery date	Depth, ft	No. of wells Producing	No. of wells Total	Production 1989 average B/d	Production Cumulative to Dec. 31, 1989 Bbl	°API gravity
		Mata, 1954	8,970-10,516	76	385	4,016	54,787,078	35.9
		Merey, 1937	5,400- 5,700	17	41	...	34,579,770	12.5
		Nipa, 1945	6,000- 8,500	45	187	1,800	120,273,230	29.6
		Oficina, 1937	5,900	34	104	1,806	361,270,333	26.1
		Oscurote-Norte, 1952	9,513	10	77	1,171	113,024,585	24.2
		Pato Este, 1988	...	2	...	93	78,502,618	41.9
		San Joaquin, 1939	6,550	66	108	2,160	48,780,081	51.3
		Soto, 1950	9,500	14	82	...	...	...
		Sta. Ana, 1936	8,500	48	97	2,473	61,975,184	45.6
		Sta. Rosa, 1941	8,500	166	210	7,901	291,608,541	45.7
		Yopales, 1937	4,600	94	203	4,990	66,410,170	22.6
		Zanjas, 1958	13,270	6	17	1,359	40,741,295	38.1
		Zapatos, 1955	11,500	28	58	3,336	181,250,848	32.4
		Zorro, 1953	11,100	8	29	1,520	74,645,449	29.3
		Zulus, 1957	12,710	7	23	1,587	24,953,350	41.2
		Zumo, 1954	9,200	4	35	910	70,616,083	25.3
		Other	...	541	2,021	98,603	2,929,648,421	...
	PDVSA/MONAGAS	Acema, 1960	...	26	56	11,743	57,397,773	26.4
		Acema-Casma	4,023	36	85	12,662	85,318,167	24.3
		Aguasay, 1955	8,100-13,400	21	72	1,354	81,535,764	41.3
		Aguasay Norte/Sur, 1955	4,849	6	17	1,675	4,946,943	42.4
		Carisito, 1984	4,881	7	8	6,767	6,168,079	41.7
		Carito, 1988	...	4	6	25,778	11,338,247	31.4
		Cerro Negro	1,200	43	296	6,444	24,737,881	9.0
		Furrial, 1986	...	17	18	136,959	80,392,219	26.3
		Jobo, 1956	3,600- 4,000	147	432	25,392	289,183,963	10.3
		Mata Acema, 1951	...	33	56	5,600	93,649,415	27.0
		Morichal, 1958	3,312	19	189	1,930	172,329,996	9.2
		Onado, 1971	4,791	5	25	1,152	19,594,004	28.0
		Oritupano, 1950	7,657	29	64	3,262	38,659,692	18.4
		Oritupano Norte/Sur, 1954	...	24	253	7,261	30,357,856	24.1
		Orocual, 1953	2,954	8	57	1,708	30,826,639	25.1
		Pilon, 1937	...	45	139	7,491	156,598,659	11.8
		Pirital, 1958	450- 1,100	...	84	...	27,535,135	...
		Quiriquire, 1928	7,000- 7,200	3	474	1,298	761,301,593	27.7
		Sta. Barbara, 1941	5,020- 6,500	1	331	6,716	169,782,969	31.4
		Tacat, 1953	1,820- 3,670	...	133	...	45,209,945	...
		Temblador, 1936	3,500- 4,500	3	49	837	109,621,745	18.7
		Other	...	63	305	28,295	615,933,764	...
	PDVSA/BARINAS	Guafita, 1984	8,500	21	22	57,226	49,921,084	29.1
		Hato, 1965	9,550	18	16	2,349	44,525,088	22.7
		La Victoria, 1987	...	6	6	11,727	6,033,547	34.5
		Maporal, 1957	10,950	12	16	3,107	17,141,820	25.7
		Paez, 1963	...	45	67	7,164	66,895,836	19.9
		Silvan, 1949	10,860	18	22	3,142	50,844,701	26.8
		Silvestre, 1948	8,860	19	48	2,849	138,382,915	22.1
		Sinco, 1953	8,500- 9,100	49	84	5,901	262,316,155	21.5
		Other	...	3	7	342	5,285,014	...
	PDVSA/GUARICO	Barzo, 1959	...	3	6	92	2,388,097	24.0
		Bella Vista, 1952	...	8	86	...	...	...
		Budare, 1958	4,523	23	44	10,977	72,274,969	31.1
		Jobal, 1960	...	8	12	74	2,200,027	33.6
		Las Mercedes, 1942	4,500	...	184	...	91,650,680	...
		Ruiz, 1949	4,500	...	42	...	33,189,615	...
		Saban, 1947	...	8	70	251	22,240,027	43.9
		Other	...	115	207	5,493	363,236,638	...
	PDVSA/AMACURO	Tucupita, 1945	...	...	48	...	67,074,189	...
	PDVSA/FALCON	All fields, 1920	...	...	...	...	107,226,375	27.4
		Total Venezuela		**12,752**	**27,995**	**1,909,105**	**43,926,451,062**	
WEST GERMANY	BEB	Annaveen, 1963	4,428	...	4	...	500,475	33.8
		Barenburg, 1953	2,300- 3,300	43	72	1,974	40,731,540	29.0
		Barver, 1963	3,640	2	5	30	502,901	32.8
		Bodenteich, 1960	4,641	1	2	18	361,509	31.1
		Eich, 1983	5,995	7	8	1,650	2,102,345	38.9
		Eilte-West, 1956	6,051	12	16	85	3,633,888	32.8
		Eldingen, 1949	5,028	36	43	723	21,262,463	35.5
		Elsfleth, 1956	5,175	3	8	35	2,860,587	25.7
		Eystrup 2, 1960	3,526	...	1	...	444,798	17.4
		Eystrup 3-6, 1959	1,075	4	4	83	1,177,255	17.4
		Eystrup-Verden, 1977	3,526	...	4	1	180,280	17.1
		Georgsdorf, 1944	1,800- 2,600	196	369	5,300	104,005,149	24.0-29.0
		Gross Lessen, 1969	3,300	6	11	557	21,231,936	30.0
		Hankensbüttel, Mitte, 1954	5,182	5	8	287	4,496,989	33.0
		Hankensbüttel-Nord, 1955	5,182	4	4	316	6,429,186	33.0
		Hankensbuttel, Ost, 1954	5,182	1	1	46	1,290,049	33.0
		Hebelermeer, 1955	3,899	5	15	73	4,550,102	27.3
		Hillerse-Nord, 1958	2,683	1	1	9	772,698	31.5
		Hillerse-West, 1957	6,077	1	1	2	29,815	43.1
		Hohenassel, 1943	1,705	6	14	22	3,558,034	30.4

	Name of field, discovery date	Depth, ft	No. of wells Producing	Total	Production 1989 average B/d	Cumulative to Dec. 31, 1989 Bbl	°API gravity
	Hohnebostel, 1969	8,341	2	6	57	1,226,842	41.0
	Königsgarten, 1984	6,235	3	3	337	247,639	38.1
	Lingen-Dal. (incl. Wd), 1942	3,129	46	128	132	16,995,157	31.1
	Lüben, 1955	3,950	7	11	585	12,445,058	35.0-38.0
	Lüben-West, 1958	4,690	5	6	133	1,586,475	36.9
	Meerdorf, 1954	6,077	14	27	62	1,632,811	43.1
	Meppen-Schwefingen, 1959	4,257	22	24	843	12,818,086	29.8
	Mölme-Feldbergen, 1934	1,410	2	2	12	597,238	31.1
	Mölme-Wachtel, 1934	3,886	2	10	3	904,044	36.9
	Nienhagen, 1909	3,079	10	26	167	26,895,965	29.6
	Nienhagen-Dachtmissen, 1959	3,427	5	8	89	1,046,892	27.8
	Pfullendorf-Ostrach, 1962	3,558	15	23	131	2,575,180	37.7
	Pötrau, 1959	5,248	...	2	...	31,121	14.3
	Rühlermoor-Malm, 1962	4,519	6	10	210	6,541,938	31.7
	Rühlermoor-Valendis, 1949	2,381	248	443	10,885	139,735,749	24.6
	Rühme, 1954	1,950	38	48	682	10,719,373	33.4
	Steimbke-Alt + Nord, 1935	1,246	18	30	76	7,756,810	20.6
	Steimbke-Lichtenmoor, 1943	2,722	14	29	109	4,020,591	17.4
	Steimbke-Ost, 1959	4,428	3	9	51	3,836,847	30.5
	Stockstadt, 1952	5,402	11	21	120	7,749,995	39.6
	Suderbruch, 1949	5,175	41	64	494	23,740,686	31.1
	Sulingen, 1973	3,345	9	9	442	5,353,332	30.0
	Varel, 1957	5,084	6	15	143	5,793,000	25.5
	Varloh, 1984	4,129	6	6	138	349,590	31.5
	Volkensen, 1960	7,540	4	4	77	807,340	22.9
	Wehrbleck, 1957	3,342	50	61	623	16,867,171	32.0
	Wietingsmoor, 1954	2,820	22	30	483	13,388,438	30.5
MOBIL	Bavaria	5,640- 6,190	...	20	...	7,526,952	20.0
	Hannover	980- 6,630	49	68	810	31,296,759	25.0-35.0
	Hofolding, 1980	11,100	3	3	300	1,105,204	28.0-30.0
	Süd-Oldenburg, 1950	2,630- 6,800	84	137	1,101	40,332,556	31.0-39.0
	Voigtei, 1953	980- 1,900	74	106	633	25,385,230	32.0-34.0
	Weser Ems	2,000- 2,450	18	25	292	6,212,439	24.0
RWE-DEA A.G.	Boostedt, 1952	5,900	26	45	502	18,568,187	32.0
	Hankensbuettel-Sued, 1954	4,900	37	81	1,881	83,272,415	27.0-35.0
	Hardesse, 1957	8,200	[illegible]	67	442	9,016,774	40.0
	Hohne, 1951	5,250	27	55	737	41,208,241	33.0
	Leiferde, 1956	2,600	21	42	364	20,524,815	33.0
	• Mittelplate, 1987	7,500- 9,350	5	6	4,517	3,500,160	19.3
	Oerrel-Sued, 1954	4,600	22	47	636	11,955,623	26.0
	Ploen-Ost, 1958	8,850	29	83	870	51,398,026	33.0
	Preetz, 1962	8,200	15	33	286	11,746,832	26.0
	Schwedeneck-See, 1978	4,900	15	18	7,053	13,124,057	28.0
	Wesendorf, 1943	4,650	13	36	347	17,648,816	25.0-40.0
	Other, 1935	2,300- 8,200	17	73	420	31,289,513	19.0-37.0
WINTERSHALL A.G.	Aitingen, 1977	6,232	4	4	933	4,668,321	31.1
	Aldorf, 1952	4,100	29	103	421	17,247,936	33.0
	Arlesried, 1964	4,920- 8,550	13	18	466	14,190,315	38.5
	Bockstedt, 1954	4,264	28	48	1,026	21,197,314	27.4
	Dickel, 1953	3,936	32	59	294	6,826,501	28.3
	Dueste, 1954	3,936	28	71	271	12,250,670	33.0
	Eicklingen, 1937	2,460	9	13	51	3,680,337	30.0
	Emlichheim, 1944	3,116	87	160	2,936	45,498,458	24.5
	Hauerz, 1985	8,639	4	4	108	290,815	40.4
	Kirchdorf, 1982	5,737	1	1	12	60,955	38.5
	Landau, 1955	3,936	77	82	1,143	27,513,710	36.9
	Maximiliansau, 1959	2,100- 5,363	...		...	14,387	41.0
	Meckelfeld, 1954	6,396	17	28	246	14,116,718	27.5
	Moenchsrot, 1958	5,248	16	22	281	10,675,677	38.1
	Nienhagen, 1925	3,729	12	12	64	10,945,356	30.0
	Oberschwarzach, 1978	4,920	4	4	113	710,515	37.7
	Pattensen, 1954	2,165	6	7	52	1,077,932	29.3
	Rheinzabern, 1959	3,750- 5,576	...	1	...	27,041	37.9
	Ruehlertwist, 1949	2,350- 2,900	70	134	1,496	32,135,700	25.0
	Ruelzheim, 1984	7,544	...	2	...	40,818	37.7
	Schwabmuenchen, 1976	4,428	...	1	...	39,491	25.7
	Schwedeneck (only onshore), 1956	5,182	13	29	177	5,275,233	27.5
	Wathlingen, 1939	2,624	7	10	24	1,422,000	30.0
DST[(e)]	Bramberge, 1958	2,560- 3,300	57	82			29.0
	Fronhofen, 1964	3,800	10	15			37.0
	Illmensee, 1967	3,800	2	5			37.0
	Markdorf, 1960	7,700	...	1			37.0
	Memmingen-M, 1958	5,000	...	7			37.0
OTHER OPERATORS[(e)]	Scheerhorn, 1949	3,550- 3,750			14,433	391,523,950	30.0
	Reitbrook, 1937	1,450- 2,100					29.0
	Oelheim-Sued, 1968	7,650	932	1,630			33.0
	Sinstorf, 1960	6,750- 7,150					
	Vorhop, 1952	2,950- 6,900					36.0
	Total West Germany		2,883	5,144	74,000	1,592,328,114	

WORLDWIDE PRODUCTION

		Name of field, discovery date	Depth, ft	No. of wells — Producing	No. of wells — Total	Production — 1989 average B/d	Production — Cumulative to Dec. 31, 1989 Bbl	°API gravity
YEMEN	HUNT OIL	Alif, 1984	5,750	55	56	152,500	118,170,200	40.0
		Al-Shura, 1989	7,600	1	1	100	41,300	40.0
		Azal, 1987	6,860	12	12	22,900	13,507,400	40.0
		Jabal, Nuqum, 1988	3,780	1	1	1,300	466,500	44.0
		Saif Ben The-Yazen, 1988	7,600	1	1	1,300	470,500	40.0
		Total North Yemen		**70**	**71**	**178,100**	**132,655,900**	
YUGOSLAVIA	INA-NAFTAPLIN	Beničanci, 1966	6,752- 5,938	34	70	5,583	106,071,189	30.2
		Bilogora, 1966	3,346- 5,052	43	60	822	8,359,466	40.8
		Bizovac, 1989	5,483- 5,499	1	5	264	32,235	33.8
		Bokšić-Klokočevci, 1975	7,218-10,171	12	19	119	234,820	31.0
		Bunjani, 1951	1,300- 2,550	19	36	69	2,514,916	30.2
		Crnac, 1977	6,814- 8,061	2	4	286	208,827	34.6
		Deletovci, 1982	3,143- 3,422	44	51	4,036	6,180,054	28.9
		Dugo Selo, 1953	3,445- 4,183	15	26	469	9,785,176	31.1
		Ferdinandovac, 1959	5,625- 5,915	5	6	102	1,286,776	36.0
		Ilača, 1982	3,445- 3,855	9	14	362	407,404	31.1
		Ivanić Grad, 1959	5,282- 5,709	46	85	3,479	44,149,246	33.4
		Jagnjedovac, 1961	2,864- 3,570	26	32	475	6,399,537	33.0
		Jamarice, 1965	3,281- 5,512	90	124	2,672	14,229,838	37.6
		Ježevo, 1963	6,234- 7,382	7	9	91	859,548	36.7
		Kloštar, 1952	2,297- 4,593	74	137	1,010	40,424,057	36.3
		Kozarice, 1972	3,281- 3,609	16	23	407	1,632,613	23.6
		Križ, 1948	1,600- 2,250	32	110	90	6,494,756	17.4
		Kučanci-Kapelna, 1973	6,562- 7,218	12	14	1,359	[illegible],110	25.2
		Lacići, 1979	7,605- 8,012	8	20	2,248	4,342,624	35.6
		Lepavina, 1969	1,780- 2,200	8	11	297	838,671	32.8
		Letičani, 1989	4,584- 4,817	5	9	108	39,285	35.0
		Lipovljani, 1960	3,937- 5,709	81	112	2,553	22,147,253	36.7
		Lupoglav, 1971	3,860- 5,600	5	5	93	140,549	33.4
		Mihovljani, 1973	5,150- 5,760	4	5	92	59,452	32.5
		Molve,(c) 1974	10,263-11,345	16	20	1,175	2,176,050	57.2
		Mramor Brdo, 1949	2,625- 4,101	4	30	49	4,539,835	31.1
		Obod, 1967	6,378- 7,550	3	8	156	2,224,427	32.5
		Okoli, 1962	7,382- 8,366	4	9	60	538,895	35.5
		Okoli,(c) 1962	7,218- 7,874	12	16	740	830,814	80.6
		Privlaka, 1983	2,933- 3,041	13	17	942	1,383,584	25.9
		Sandrovac, 1962	2,250- 3,700	105	156	4,237	37,966,186	37.8
		Števkovica, 1978	7,710- 9,843	22	33	883	3,842,985	31.9
		Struzec, 1956	2,362- 3,773	66	107	5,520	101,300,919	38.8
		Vezišće, 1965	6,135- 6,562	5	5	19	47,989	31.6
		Žutica, 1963	5,742- 6,923	154	194	7,696	86,049,116	33.8
		Other,(c)	5,250-11,800	10	19	1,375	2,599,630	87.9
	NAFTA-GAS	Boka, 1956	3,969- 4,100	25	43	544	7,815,100	32.7
		Čoka, 1975	4,888- 5,046	9	23	205	3,665,890	44.3
		Elemir, 1959	5,002- 5,376	29	63	520	17,377,400	32.7
		Itebej, 1978	6,973- 7,327	5	16	43	204,290	26.4
		Janošik, 1958	2,148- 3,293	1	4	16	144,766	24.2
		Jermenovci, 1952	2,919- 3,148	56	100	731	9,415,246	24.2
		Karadjordjevo, 1973	8,308- 8,846	6	22	146	1,069,360	26.4
		Kelebija, 1970	2,061- 2,788	12	28	546	6,461,960	21.2
		Kikinda, 1960	3,543- 5,735	166	229	4,632	38,380,480	34.9
		Kikinda-varoš, 1963	3,740- 6,490	50	69	2,028	28,532,000	27.9
		Lokve, 1953	2,909- 3,099	9	26	42	731,325	25.1
		Mokrin, 1961	6,232- 7,216	105	186	2,525	19,858,100	35.1
		Mokrin-jug, 1982	6,658- 6,740	16	23	556	1,011,460	41.1
		Majdan, 1972	7,708- 7,790	14	29	270	565,300	37.4
		Palić, 1968	3,345- 3,427	6	34	55	1,668,950	45.9
		V. Greda-jug, 1981	3,237- 3,427	10	22	145	292,250	23.8
		Velebit, 1965	2,434- 2,575	122	159	7,830	45,461,540	22.8
		Zrenjanin, 1974	6,829- 6,986	5	11	321	142,260	25.0
		Total Yugoslavia		**1,671**	**2,728**	**77,178**	**709,768,649**	
ZAIRE	CHEVRON	• GCO, 1970	7,000- 9,000	5	7	169	6,394,909	38.7
		• Libwa, 1981	5,500	...	2	...	...	33.0
		• Lukami, 1983	12,400	4	5	1,388	7,396,373	33.2
		• Mibale, 1973	5,000- 6,000	8	9	10,460	89,011,881	30.0
		• Motoba, 1976	11,098	7	7	5,439	2,152,540	31.5
		• Mwambe, 1979	6,150	1	1	143	736,610	29.7
	ZAIREP (FINA)	East Mibale, 1978	6,000	...	1	...	397,600	34.0
		Kiluku, 1983	3,400	1	1	16	51,000	31.0
		Kinkasi, 1972	3,700	37	42	2,411	8,182,400	31.0
		Liawenda, 1972	3,900	29	36	1,659	4,020,500	31.0
		Makelekese, 1983	3,600	8	8	388	10,357,000	31.0
		Muanda, 1972	3,600	6	7	371	821,500	31.0
		Nsiamfumu, 1977	8,300	...	1	...	5,000	34.0
		Tshiende, 1978	6,000	4	8	4,341	7,612,900	34.0
		Total Zaire		**110**	**135**	**29,385**	**127,818,913**	

U.S. fields with reserves exceeding 100 million bbl

State Field Disc. date	1990 prod.	Cum. prod. 1-1-91	Est. rem. reserves	Est. No. wells
	1,000 bbl			
ALABAMA*				
Citronelle, 1955	1,596	151,242	3,619	443
ALASKA				
Endicott, 1978	37,740	120,083	255,260	55
Granite Point, 1965	1,533	113,270	15,467	26
Kuparuk River, 1969	109,029	725,268	775,971	345
Lisburne, 1967	14,827	64,126	146,173	70
McArthur River, 1965	4,540	540,098	35,460	82
Middle Ground Shoal, 1962	3,179	161,655	4,821	42
Prudhoe Bay, 1967	*473,607	†7,078,307	4,421,693	769
Swanson River, 1957	1,852	213,192	6,148	30
ARKANSAS*				
Smackover, 1922	2,292	561,971	5,708	1,975
CALIFORNIA				
San Joaquin Valley				
Belridge South, 1911	54,181	791,489	320,880	4,301
Buena Vista, 1909	1,602	650,446	35,099	764
Coalinga, 1890	11,509	775,574	139,459	2,042
Coalinga Nose, 1938	883	500,663	7,451	75
Coles Levee North, 1938	384	161,290	3,383	69
Cuyama South, 1949	380	219,041	6,088	92
Cymric,1909	8,919	218,038	76,302	959
Edison, 1928	861	136,529	17,503	594
Elk Hills, 1911	31,298	958,982	528,894	1,006
Fruitvale, 1928	447	116,511	12,751	217
Greeley, 1936	120	112,964	1,446	25
Kern Front, 1912	2,191	176,717	51,579	799
Kern River, 1899	44,080	1,297,104	650,375	6,779
Kettleman North Dome, 1928	172	456,998	948	45
Lost Hills, 1910	6,403	190,280	60,280	1,650
McKittrick, 1896	1,648	270,873	86,868	760
Midway-Sunset, 1894	58,906	1,997,711	255,499	9,385
Mount Poso, 1926	5,617	275,072	67,458	468
Rio Bravo, 1937	57	116,220	507	11
Yowlumne, 1974	4,722	92,112	17,199	63
Coastal Area				
Carpinteria, 1966	1,878	92,184	15,632	125
Cat Canyon E. & W., 1908	1,332	291,721	29,203	325
Dos Cuadras, 1969	3,468	220,392	46,552	138
Elwood, 1928	209	106,206	1,782	7
Hondo, 1969	8,240	107,986	94,128	24
Orcutt, 1901	858	167,526	8,586	137
Point Pedernales, 1982†	6,392	24,312	*48,171	10
Rincon, 1927	980	150,834	14,095	180
San Ardo, 1947	4,110	416,038	115,216	430
Santa Maria Valley, 1934	1,037	200,635	18,209	125
South Mountain, 1916	719	147,396	10,623	361
Ventura, 1919	6,534	908,069	83,699	468
Los Angeles Basin				
Beta, 1976	4,613	50,601	104,326	71
Beverly Hills, 1900	1,838	126,329	38,643	91
Brea Olinda, 1880	1,948	388,032	50,649	727
Coyote East, 1909	556	109,766	12,109	91
Coyote West, 1909	613	251,284	6,166	65
Dominguez, 1923	569	270,419	6,295	106
Huntington Beach, 1920	3,842	1,075,320	63,092	562
Inglewood, 1924	2,380	350,534	49,068	262
Long Beach, 1921	2,189	914,172	12,801	338
Montebello, 1917	565	193,520	9,104	127
Richfield, 1919	1,152	191,737	24,840	192
Santa Fe Springs, 1919	1,012	615,060	18,379	140
Seal Beach, 1924	746	204,641	12,595	157
Torrance, 1922	1,259	214,857	33,073	278
Wilmington, 1932	26,118	2,344,984	442,878	1,695
COLORADO*				
Rangely, 1933	12,125	763,829	37,000	521
FLORIDA*				
Jay, 1970	4,335	369,712	46,844	55
ILLINOIS*				
Clay City, 1938	2,092	398,160	3,908	2,860
Lawrence, 1906	2,546	399,887	7,000	831
Louden, 1938	876	390,337	1,924	739
Main, 1906	1,710	237,023	4,500	1,487
New Harmony, 1938	800	155,293	3,600	569
Salem, 1938	865	228,312	3,300	129
KANSAS*				
Bemis-Shutts, 1928	1,120	246,359	3,200	807
Chase-Silica, 1931	850	303,808	2,730	914
El Dorado, 1917	840	300,226	1,500	776
Hall-Gurney, 1931	905	148,038	2,500	1,021
Trapp, 1937	1,050	228,497	2,526	844
LOUISIANA*				
Offshore				
•Bay Marchand Blk. 2, 1949	8,825	615,097	41,175	223
•Eugene Island Blk. 330, 1930	6,665	284,395	40,603	131
•Grande Isle Blk. 16, 1948	3,373	270,714	78,660	53
•Grande Isle Blk. 43, 1956	3,900	281,328	76,616	91
•Mississippi Canyon Blk. 194, 1980	—	—	—	35
•Main Pass Blk. 41, 1957	2,025	242,831	18,407	77
•Main Pass Blk. 306, 1969	1,560	205,145	75,059	92
•South Marsh Island Blk. 128, 1974	—	93,063	15,464	79
•South Pass Blk. 27, 1954	3,650	135,410	65,250	315
•South Pass Blk. 61, 1968	4,600	165,007	35,400	151
•South Pass Blk. 62, 1965	3,225	111,804	76,154	87
•South Pass Blk. 65, 1965	2,550	107,361	82,764	60
•Ship Shoal Blk. 204, 1968	990	68,068	36,932	31
•Ship Shoal Blk. 207, 1967	750	89,384	36,434	25
•Ship Shoal Blk. 208, 1962	2,811	166,532	58,911	49
•South Timbalier Blk. 21, 1939	1,836	220,103	43,269	46
•South Timbalier Blk. 135, 1956	1,107	141,956	23,044	35
•West Delta Blk. 30, 1949	5,339	457,119	36,336	144
•West Delta Blk. 73, 1962	2,950	195,766	79,225	72
Onshore South				
Bay de Chene, 1941	305	97,131	17,203	27
Bay St. Elaine, 1928	396	165,720	24,380	25
Bayou Sole, 1941	502	162,639	2,147	27
Black Bay West, 1953	1,780	148,739	6,492	68
Caillou Island, 1930	1,765	606,492	69,759	146
Cote Blanche Bay West, 1940	550	183,512	44,456	79
Delta Farms, 1944	590	116,241	6,129	33
Garden Island Bay, 1934	1,085	223,486	29,729	143
Golden Meadow, 1938	568	136,679	3,050	156
Grand Bay, 1938	450	171,372	2,902	37
Hackberry, East, 1927	586	110,129	6,561	62
Hackberry, West, 1928	1,075	144,446	3,941	113
Iowa, 1931	97	99,544	456	26
Jennings, 1901	210	116,859	600	183
Lafitte, 1935	1,221	257,845	7,009	111
Lake Barre, 1929	885	205,940	18,144	42
Lake Pelto, 1929	402	117,990	16,425	27
Lake Washington, 1931	2,403	247,439	11,327	93
Leeville, 1931	556	142,766	6,101	44
Paradis, 1939	607	127,905	7,345	36
Quarantine Bay, 1937	883	174,311	14,117	42
Timbalier Bay, 1938 onshore	567	297,734	22,607	64
Venice, 1937	669	183,423	6,045	60

*Includes 33.18 million bbl of condensate †Includes 201.17 million bbl of condensate

*Revised to reflect only developed portion of field
Original estimate of total field reserves is 350 million bbl

State Field Disc. date	1990 prod.	Cum. prod. 1-1-91	Est. rem. reserves	Est. No. wells
		1,000 bbl		
Vinton, 1910	297	161,610	775	106
Weeks Island, 1945	930	227,925	19,370	36
West Bay, 1940	845	230,339	14,262	69
North				
Caddo-Pine Island 1905	2,820	367,007	8,900	11,608
Delhi, 1944	530	212,789	33,569	65
Haynesville, 1921	608	169,697	2,000	142
Homer, 1919	355	99,138	2,375	196
Rodessa, 1935	350	106,785	2,461	89

MICHIGAN*

State Field Disc. date	1990 prod.	Cum. prod. 1-1-91	Est. rem. reserves	Est. No. wells
Albion-Scipio, 1957	43	>132,173	9,957	382

MISSISSIPPI*

State Field Disc. date	1990 prod.	Cum. prod. 1-1-91	Est. rem. reserves	Est. No. wells
Baxterville, 1944	1,986	243,366	6,189	192
Heidelberg, 1944	2,390	179,630	7,350	234
Tinsley, 1939	649	220,985	1,889	99

MONTANA*

State Field Disc. date	1990 prod.	Cum. prod. 1-1-91	Est. rem. reserves	Est. No. wells
Bell Creek, 1967	601	130,770	21,670	101
Cut Bank, 1926	765	163,912	35,655	615
Pine, 1951	1,170	107,571	3,238	97

NEW MEXICO

State Field Disc. date	1990 prod.	Cum. prod. 1-1-91	Est. rem. reserves	Est. No. wells
Denton, 1949	810	140,363	5,000	175
Empire-Abo, 1957	1,231	222,783	47,217	398
Eunice-Monument, 1929	2,260	130,594	5,714	857
Hobbs, 1928	6,590	311,019	17,500	583
Maljamar, 1926	1,653	148,408	4,800	848
Vacuum, 1929	9,327	452,107	30,673	1,245

NORTH DAKOTA*

State Field Disc. date	1990 prod.	Cum. prod. 1-1-91	Est. rem. reserves	Est. No. wells
Beaver Lodge, 1951	1,520	114,490	13,666	65
Billings Nose, 1978	1,941	65,097	47,767	204
Little Knife, 1977	2,158	55,751	53,254	135
Mondak, 1976	295	13,643	82,326	113

OKLAHOMA*

State Field Disc. date	1990 prod.	Cum. prod. 1-1-91	Est. rem. reserves	Est. No. wells
Burbank, 1920	890	538,530	6,593	1,031
Eola-Robberson, 1921	825	134,805	6,529	507
Fitts, 1933	2,292	204,692	7,208	568
Glenn Pool, 1905	815	329,581	3,285	618
Golden Trend, 1945	3,489	481,275	23,750	1,238
Healdton, 1913	1,527	337,949	6,259	968
Hewitt, 1919	1,970	272,323	10,030	740
Oklahoma City, 1928	984	818,103	4,033	193
Postle, 1960	1,050	108,569	12,745	218
Sho-Vel-Tum, 1919	16,595	1,200,895	34,405	6,982
Sooner Trend, 1965	3,466	302,872	12,672	3,404

TEXAS

State Field Disc. date	1990 prod.	Cum. prod. 1-1-91	Est. rem. reserves	Est. No. wells
Railroad Commission				
District 2-South				
Greta, 1933	474	148,558	11,542	97
Lake Pasture, 1953	1,698	91,222	9,206	197
Tom O'Connor, 1934	5,950	760,230	42,618	648
West Ranch, 1938	1,901	384,115	6,599	304
District 3-Gulf Coast				
Anahuac, 1935	610	286,230	13,770	94
Conroe, 1931	2,484	732,474	28,469	263
Giddings, 1971	9,593	280,418	175,750	2,380
Hastings, 1934	1,819	697,023	68,912	188
Magnet Withers, 1936	1,411	113,824	2,797	141
Oyster Bayou, 1941	670	161,619	16,681	35
Thompson, 1931	2,319	478,390	21,510	199
Tomball, 1933	279	121,629	9,295	66
Webster, 1937	3,708	580,906	12,292	192
District 4-South				
Agua Dulce-Stratton, 1928	340	147,323	24,051	132
Borregos, 1945	138	114,340	19,867	39
Kelsey, 1938	178	115,253	35,853	59
Plymouth, 1925	205	123,268	2,855	65
Seeligson, 1925	179	271,869	55,158	64
TCB, 1944	48	113,088	52,150	16
White Point, E, 1938	90	104,217	6,157	58
District 5-East				
Alabama Ferry, 1983	2,111	19,263	81,737	272
Van, 1928	2,547	527,258	11,320	432
District 6-East				
East Texas, 1930	34,704	5,078,708	918,797	9,501
Fairway, 1960	1,830	196,602	13,866	100
Hawkins, 1940	6,350	834,798	29,218	436
Neches, 1953	960	105,911	4,105	172
Quitman, 1948	1,211	123,817	5,969	173
District 7C-West Central				
Big Lake, 1923	519	130,935	2,505	70
District 8-West				
Andector, 1946	591	183,124	5,264	42
Block 31, 1945	2,747	225,865	9,253	271
Cowden, N., 1930	14,897	516,488	45,000	1,352
Cowden, S. Foster, Johnson, 1932	8,425	517,944	27,000	1,678
Dollarhide, 1945	2,585	198,896	9,000	221
Dune, 1938	2,368	187,696	14,008	750
Fullerton, 1942	7,575	362,975	7,225	912
Goldsmith, 1934	5,690	767,662	21,606	1,562
Howard Glasscock, 1925	6,009	415,125	15,383	2,157
Iatan, E., 1926	3,016	148,765	7,215	1,314
Jordan, 1937	824	130,676	2,050	240
Keystone, 1930	1,511	316,163	6,291	756
McElroy, 1926	8,888	481,085	41,264	1,954
Means, 1934	6,265	240,671	30,000	744
Midland Farms, 1944	2,655	248,211	12,385	292
Sand Hills, 1931	2,030	252,553	17,254	1,305
TXL, 1944	1,415	266,431	3,585	600
Waddell, 1927	555	101,855	2,649	193
Ward Estes, N., 1929	4,213	371,258	69,355	1,621
Westbrook, 1923	2,110	92,114	11,890	667
Yates, 1926	22,001	1,221,306	733,199	1,023
District 8A-West				
Anton-Irish, 1944	2,978	182,423	18,092	245
Cogdell Area, 1949	1,199	294,722	38,700	208
Diamond M., 1948	1,845	242,595	12,886	317
Kelly-Snyder, 1948	8,608	1,262,074	87,926	787
Levelland, 1938	17,105	517,105	55,200	3,250
Prentice, 1951	5,002	171,294	22,300	413
Salt Creek, 1950	10,335	268,091	27,665	196
Seminole, 1936	16,845	557,909	110,383	449
Slaughter, 1936	17,898	1,065,551	135,550	3,018
Spraberry Trend, 1951	18,490	690,622	37,809	7,546
Wasson, 1936	25,937	1,764,036	140,961	2,046
Welch, 1942	3,106	150,334	25,911	651
District 10-Panhandle				
Panhandle, 1921	6,859	1,436,157	30,000	12,263

UTAH*

State Field Disc. date	1990 prod.	Cum. prod. 1-1-91	Est. rem. reserves	Est. No. wells
Altamont, 1955	2,815	94,614	235,000	232
Aneth, 1956	5,513	365,083	23,225	463
East Anschutz Ranch, 1979	7,320	97,066	710,417	40
Red Wash, 1951	914	79,526	11,413	154

WYOMING*

State Field Disc. date	1990 prod.	Cum. prod. 1-1-91	Est. rem. reserves	Est. No. wells
Brady, 1973	1,514	57,990	45,705	22
Byron, 1918	830	122,457	5,828	61
Elk Basin, 1915	2,695	437,536	20,080	179
Frannie, 1928	730	117,601	3,338	62
Garland, 1906	2,495	167,933	7,790	229
Grass Creek, 1914	2,114	189,626	5,850	283
Hamilton Dome, 1918	2,390	235,210	5,800	245
Hartzog Draw, 1976	4,875	77,141	272,983	160
Hilite, 1969	467	76,392	54,906	100
Lance Creek, 1918	146	108,075	250	27
Little Buffalo Basin, 1914	2,121	123,[illegible]3	6,879	174
Lost Soldier, 1916	3,000	213,724	7,500	92
Oregon Basin, 1912	7,511	403,895	17,489	506
Painter Reservoir, 1979	1,320	47,559	77,780	35
Salt Creek, 1889	4,162	638,489	16,041	1,218
Wertz, 1921	2,500	106,267	15,000	65
Whitney Canyon-Carter Creek, 1978	1,286	12,296	102,262	32

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*Petroleum Information data

•Offshore

Crude oil prices

	$/bbl												
	U.S. refiner acquisition cost			U.S. landed cost of imports							Average export prices		
					Selected countries								
Year	Domestic	Imported	Composite	Total	Canada	Mexico	United Kingdom	Nigeria	Saudi Arabia	Venezuela	Worldwide	OPEC	Non-OPEC
1976	8.84	13.48	10.89	13.34	13.57	NA	NA	13.80	13.04	11.80	NA	NA	NA
1977	9.55	14.53	11.96	14.31	14.21	13.75	NA	15.25	13.61	13.13	NA	NA	NA
1978	10.61	14.57	12.46	14.38	14.50	13.54	NA	14.86	13.92	12.83	NA	NA	NA
1979	14.27	21.67	17.72	21.65	20.43	20.86	22.16	22.96	19.15	18.18	NA	NA	NA
1980	24.29	33.89	28.07	33.95	30.47	31.80	35.88	37.05	30.02	25.86	NA	NA	NA
1981	34.93	37.05	35.24	36.52	32.16	33.78	37.24	39.70	34.19	29.87	34.81	34.42	36.16
1982	31.22	33.55	31.87	33.18	26.92	26.64	34.28	36.17	35.00	24.82	33.33	33.71	32.3
1983	28.87	29.30	28.99	28.93	25.63	25.78	30.87	30.84	29.76	22.94	29.66	29.89	29.13
1984	28.53	28.88	28.63	28.46	26.59	26.87	29.60	30.50	29.50	25.15	28.60	28.61	28.6
1985	26.66	26.99	25.75	26.66	25.71	25.63	28.35	28.96	24.72	24.43	27.60	28.00	26.98
1986	14.82	14.00	14.55	13.49	13.43	12.17	14.63	15.29	12.84	11.52	14.98	15.45	14.21
1987	17.76	18.13	17.90	17.65	17.04	16.69	18.78	19.32	16.81	15.76	17.41	17.31	17.57
1988	14.74	14.56	14.67	14.08	15.15	12.58	15.82	15.88	13.37	13.66	13.79	13.67	14.04
1989	17.88	18.08	17.97	17.68	18.35	16.35	18.74	19.19	17.33	16.78	16.65	16.40	17.11

From: Oil & Gas Journal Energy Database
Source: U.S. Department of Energy

Petroleum product prices

	(¢/gallon)												
	Motor gasoline-pump price					Refiner resale (wholesale) product prices							
Year	Leaded Regular	Unleaded Regular	Unleaded Premium	Average All-Types	Heating Oil Residential	Motor Gasoline	Aviation Gasoline	Kerosene Jet Fuel	Kerosene	No. 2 Fuel Oil	No. 2 Diesel Oil	Propane	Resid
1978	62.60	67.00	NA	65.20	49.00	43.40	53.70	38.60	40.40	36.90	36.50	23.70	26.30
1979	85.70	90.30	NA	88.20	70.40	63.70	72.10	66.00	62.40	56.90	57.40	29.10	39.90
1980	119.10	124.50	NA	122.10	97.40	94.10	112.80	86.80	86.40	80.30	80.10	41.50	52.80
1981	131.10	137.80	147.00	135.30	119.40	106.40	125.00	101.20	106.60	97.60	97.20	46.60	66.30
1982	122.20	129.60	141.50	128.10	116.00	97.30	122.80	95.30	101.80	91.40	91.40	42.70	61.20
1983	115.70	124.10	138.30	122.50	107.80	88.20	117.80	85.40	89.20	81.50	80.80	48.40	60.90
1984	112.90	121.20	136.60	119.80	109.10	83.20	116.50	83.00	91.60	82.10	80.30	45.00	65.40
1985	111.50	120.20	134.00	119.60	105.30	83.50	113.00	79.40	87.40	77.60	77.20	39.80	57.70
1986	85.70	92.70	108.50	93.10	83.60	53.10	91.20	49.50	60.60	48.60	45.20	29.00	30.50
1987	89.70	94.80	109.30	95.70	80.30	58.90	85.90	53.80	59.20	52.70	53.40	25.20	38.50
1988	89.90	94.60	110.70	96.30	81.30	57.70	85.00	49.50	54.90	47.30	47.30	24.00	30.00
1989	99.80	102.10	119.70	106.00	90.00	65.50	95.00	58.40	66.90	56.50	56.80	24.60	35.80

From: Oil & Gas Journal Energy Database
Source: U.S. Department of Energy

Comparative energy prices

	Natural gas delivered to consumers					Cost of fossil fuels delivered to utilities				Electricity retail prices			
	($/MCF)					(¢/Million BTU)				(¢/Kilowatt Hour)			
Year	Residential	Commercial	Industrial	Electric Utilities	Average	Coal	Heavy oil	Natural gas	All fuels	Residential	Commercial	Industrial	Total
1973	1.29	0.94	0.50	0.38	0.68	40.5	78.5	33.8	47.6	2.54	2.41	1.25	1.96
1974	1.46	1.07	0.67	0.51	0.84	70.9	189.0	48.2	91.4	3.10	3.04	1.69	2.49
1975	1.71	1.35	0.96	0.77	1.12	81.4	200.5	75.2	104.4	3.51	3.45	2.07	2.92
1976	1.98	1.64	1.24	0.98	1.37	84.8	195.2	103.4	111.9	3.73	3.69	2.21	3.09
1977	2.35	2.04	1.50	1.32	1.66	94.7	219.8	129.1	129.7	4.05	4.09	2.50	3.42
1978	2.56	2.23	1.70	1.48	1.85	111.6	212.5	142.2	141.1	4.31	4.36	2.79	3.69
1979	2.98	2.73	1.99	1.81	2.21	122.4	298.8	174.9	163.9	4.64	4.68	3.05	3.99
1980	3.68	3.39	2.56	2.27	2.80	135.1	426.7	219.9	192.8	5.36	5.48	3.69	4.73
1981	4.29	4.00	3.14	2.89	3.39	153.2	533.4	280.5	225.6	6.20	6.29	4.29	5.46
1982	5.17	4.82	3.87	3.48	4.15	164.70	483.0	337.6	224.9	6.86	6.86	4.95	6.13
1983	6.06	5.59	4.18	3.58	4.82	165.60	467.0	347.4	220.6	7.18	7.01	4.97	6.29
1984	6.12	5.55	4.22	3.70	4.85	166.40	481.0	360.3	219.1	7.54	7.33	5.04	6.52
1985	6.12	5.50	3.95	3.55	4.72	164.8	424.4	344.4	209.4	7.79	7.47	5.16	6.71
1986	5.83	5.08	3.23	2.43	4.13	157.9	240.1	235.1	175.0	7.41	7.13	4.90	6.42
1987	5.54	4.77	2.94	2.32	4.05	150.6	297.6	224.0	170.6	7.41	7.01	4.72	6.32
1988	5.47	4.63	2.95	2.33	4.09	146.6	240.5	226.3	164.3	7.49	7.07	4.62	6.31
1989	5.64	4.74	2.97	2.43	4.22	144.5	284.6	235.5	167.5	7.64	7.23	4.69	6.43

From Oil & Gas Journal Energy Database
Source: U.S. Department of Energy

Price history, crude oil, natural gas and motor gasoline

	Actual current prices						Inflation adjusted real prices				
	Crude oil			Natural gas			Crude oil			Natural gas	
Year	U.S. average wellhead $/bbl	West Texas Inter-mediate posted $/bbl	Motor Gasoline leaded pump price $/gal	U.S. average wellhead $/Mcf	Consumer average $/Mcf	Producer Price index 1982-100	U.S. average wellhead $/bbl	West Texas Inter-mediate posted $/bbl	Motor Gasoline Leaded pump price $/gal	U.S. average wellhead $/Mcf	Consumer average $/Mcf
1925	1.68	1.79	0.222	0.094	0.223	17.8	9.438	10.056	1.247	0.528	1.253
1926	1.88	1.90	0.234	0.095	0.229	17.2	10.930	11.047	1.359	0.552	1.311
1927	1.30	1.28	0.211	0.088	0.220	16.5	7.879	7.758	1.278	0.533	1.333
1928	1.17	1.36	0.209	0.089	0.232	16.7	7.006	8.144	1.254	0.533	1.389
1929	1.27	1.45	0.214	0.082	0.216	16.4	7.744	8.841	1.306	0.500	1.317
1930	1.19	0.95	0.200	0.076	0.214	14.9	7.987	6.376	1.339	0.510	1.436
1931	0.65	0.77	0.170	0.070	0.233	12.6	5.159	6.111	1.348	0.556	1.849
1932	0.87	0.69	0.179	0.064	0.247	11.2	7.768	6.161	1.601	0.571	2.205
1933	0.67	1.00	0.178	0.062	0.237	11.4	5.877	8.772	1.563	0.544	2.079
1934	1.00	1.00	0.189	0.060	0.223	12.9	7.752	7.752	1.461	0.465	1.729
1935	0.97	1.00	0.188	0.058	0.224	13.8	7.029	7.246	1.365	0.420	1.623
1936	1.09	1.10	0.195	0.055	0.220	13.9	7.842	7.914	1.399	0.396	1.583
1937	1.18	1.22	0.200	0.051	0.220	14.9	7.919	8.188	1.342	0.342	1.477
1938	1.13	1.02	0.195	0.049	0.218	13.5	8.370	7.556	1.445	0.363	1.615
1939	1.02	1.02	0.188	0.049	0.216	13.3	7.669	7.699	1.410	0.368	1.624
1940	1.02	1.02	0.184	0.045	0.217	13.5	7.556	7.556	1.364	0.333	1.607
1941	1.14	1.17	0.192	0.049	0.221	15.1	7.550	7.748	1.274	0.325	1.464
1942	1.19	1.17	0.204	0.051	0.227	17.0	7.000	6.882	1.202	0.300	1.335
1943	1.20	1.17	0.205	0.052	0.223	17.8	6.742	6.573	1.153	0.292	1.253
1944	1.21	1.17	0.206	0.051	0.215	17.9	6.760	6.536	1.150	0.285	1.201
1945	1.22	1.17	0.205	0.049	0.214	18.2	6.703	6.429	1.126	0.269	1.176
1946	1.41	1.36	0.208	0.053	0.220	20.8	6.779	6.524	0.999	0.255	1.058
1947	1.93	1.84	0.231	0.060	0.232	25.6	7.539	7.188	0.903	0.234	0.906
1948	2.60	2.57	0.259	0.065	0.241	27.7	9.386	9.278	0.934	0.235	0.870
1949	2.54	2.57	0.268	0.063	0.254	26.3	9.658	9.772	1.019	0.240	0.966
1950	2.51	2.57	0.268	0.065	0.266	27.3	9.194	9.414	0.980	0.238	0.974
1951	2.53	2.57	0.272	0.073	0.298	30.4	8.322	8.454	0.893	0.240	0.980
1952	2.53	2.57	0.276	0.078	0.332	29.6	8.547	8.682	0.931	0.264	1.122
1953	2.68	2.72	0.287	0.092	0.355	29.2	9.178	9.298	0.983	0.315	1.216
1954	2.78	2.82	0.290	0.101	0.381	29.3	9.488	9.625	0.991	0.345	1.300
1955	2.77	2.82	0.291	0.104	0.400	29.3	9.454	9.625	0.992	0.355	1.365
1956	2.79	2.82	0.299	0.108	0.415	30.3	9.208	9.307	0.988	0.356	1.370
1957	3.09	3.04	0.310	0.113	0.431	31.2	9.904	9.753	0.992	0.362	1.381
1958	3.01	3.06	0.304	0.119	0.462	31.6	9.525	9.677	0.961	0.377	1.462
1959	2.90	2.98	0.305	0.129	0.477	31.7	9.148	9.385	0.962	0.407	1.505
1960	2.88	2.97	0.311	0.140	0.500	31.7	9.085	9.369	0.982	0.442	1.577
1961	2.89	2.97	0.308	0.151	0.510	31.6	9.146	9.399	0.973	0.478	1.614
1962	2.90	2.97	0.306	0.155	0.514	31.7	9.148	9.369	0.967	0.489	1.621
1963	2.89	2.97	0.304	0.158	0.512	31.6	9.146	9.399	0.963	0.500	1.620
1964	2.88	2.95	0.304	0.154	0.519	31.6	9.114	9.320	0.962	0.487	1.642
1965	2.86	2.92	0.312	0.156	0.522	32.3	8.854	9.040	0.966	0.483	1.616
1966	2.88	2.94	0.321	0.157	0.523	33.3	8.649	8.817	0.964	0.471	1.571
1967	2.92	3.03	0.332	0.160	0.520	33.4	8.743	9.060	0.994	0.479	1.557
1968	2.94	3.07	0.337	0.164	0.504	34.2	8.596	8.977	0.985	0.480	1.474
1969	3.09	3.30	0.348	0.167	0.515	35.6	8.680	9.256	0.978	0.469	1.447
1970	3.18	3.35	0.357	0.171	0.550	36.9	8.618	9.079	0.967	0.463	1.491
1971	3.39	3.56	0.364	0.182	0.590	38.0	8.921	9.368	0.958	0.479	1.553
1972	3.39	3.56	0.361	0.186	0.630	39.8	8.518	8.945	0.907	0.467	1.583
1973	3.89	3.87	0.388	0.216	0.680	45.0	8.644	8.604	0.862	0.480	1.511
1974	6.74	10.37	0.532	0.304	0.840	53.5	12.598	19.383	0.994	0.568	1.570
1975	7.56	11.16	0.567	0.445	1.120	58.4	12.945	19.110	0.971	0.762	1.918
1976	8.14	12.65	0.590	0.580	1.370	61.1	13.322	20.704	0.966	0.949	2.242
1977	8.57	14.30	0.622	0.790	1.660	64.9	13.205	22.034	0.958	1.217	2.558
1978	8.96	14.85	0.626	0.905	1.850	69.9	12.818	21.245	0.896	1.295	2.647
1979	12.51	22.40	0.857	1.178	2.210	78.7	15.896	28.463	1.089	1.497	2.808
1980	21.59	37.37	1.191	1.590	2.800	89.7	24.069	41.661	1.328	1.773	3.122
1981	31.77	36.67	1.311	1.980	3.390	98.0	32.418	37.418	1.338	2.020	3.459
1982	28.52	32.75	1.222	2.460	4.150	100.0	28.520	32.750	1.222	2.460	4.150
1983	26.19	30.25	1.157	2.590	4.820	101.2	25.879	29.891	1.143	2.559	4.763
1984	25.88	29.83	1.129	2.660	4.850	103.6	24.981	28.793	1.090	2.568	4.681
1985	24.09	28.08	1.115	2.510	4.720	103.1	23.366	27.236	1.081	2.435	4.578
1986	12.51	16.44	0.857	1.940	4.130	100.1	12.498	16.421	0.856	1.938	4.046
1987	15.40	18.21	0.897	1.670	4.050	102.8	14.981	17.714	0.873	1.625	3.940
1988	12.58	15.52	0.899	1.690	4.090	106.9	11.768	14.518	0.841	1.581	3.826
1989	15.85	18.29	0.998	1.690	4.220	112.2	14.127	16.301	0.889	1.506	3.761

From: Oil & Gas Journal Energy Database
Source: U.S. Department of Energy

Worldwide production statistics

NORTH AMERICA

Upper figures = 1,000 b/d
Lower figures = million t/y

	1940	1950	1960	1970	1980	1982	1983	1984	1985	1986	1987	1988	1989	1990
Canada	23.5 1.2	79.6 4.0	525.6 26.2	1,263.6 62.9	1,412.0 70.3	1,233.0 61.4	1,396.0 69.5	1,430.0 71.2	1,453.0 72.4	1,475.3 73.5	1,508.3 75.1	1,604.6 79.9	1,588.0 79.1	1,508.0 75.1
United States	3,707.4 184.6	5,407.1 269.3	7,054.6 351.3	9,630.0 479.6	8,569.0 426.7	8,655.0 431.0	8,669.0 431.7	8,750.0 435.8	8,919.0 444.2	8,790.0 437.7	8,276.7 412.2	8,165.9 406.7	7,675.6 382.2	7,220.0 359.6
Total	**3,730.9** **185.8**	**5,486.7** **273.3**	**7,580.2** **377.5**	**10,893.6** **542.5**	**9,981.0** **497.0**	**9,888.0** **492.4**	**10,065.0** **501.2**	**10,180.0** **507.0**	**10,372.0** **516.6**	**10,265.3** **511.2**	**9,785.0** **487.3**	**9,770.5** **486.6**	**9,263.6** **461.3**	**8,728.0** **434.7**

MIDDLE EAST

Upper figures = 1,000 b/d
Lower figures = million t/y

	1940	1950	1960	1970	1980	1982	1983	1984	1985	1986	1987	1988	1989	1990
Abu Dhabi	... ...	... ...	... ...	693.8 34.6	1,350.0 67.2	883.0 44.0	757.0 37.7	750.0 37.4	705.1 35.1	949.0 47.3	969.4 48.3	1,012.6 50.4	1,359.0 67.7	1,587.0 79.0
Bahrain	19.3 1.0	30.2 1.5	45.1 2.2	76.6 3.8	48.0 2.4	45.0 2.2	41.0 2.0	41.0 2.0	41.9 2.1	44.0 2.2	43.2 2.2	42.3 2.1	42.2 2.1	42.0 2.1
Dubai	... ...	... ...	... ...	... ...	349.0 17.4	357.0 17.8	327.0 16.3	324.0 16.1	348.0 17.3	350.0 17.4	381.2 19.0	355.3 17.7	410.6 20.4	469.0 23.4
Iran	181.2 9.0	664.3 33.1	1,067.6 53.2	3,328.8 165.8	1,467.0 73.1	1,896.0 94.4	2,606.0 129.8	2,166.0 107.9	2,279.0 113.5	1,806.3 90.0	2,341.7 116.6	2,207.5 109.9	2,934.3 146.1	3,120.0 156.4
Iraq	60.7 3.0	136.2 6.8	1,004.2 50.0	1,548.6 77.1	2,638.0 131.4	914.0 45.5	905.0 45.1	1,218.0 60.7	1,396.8 69.6	1,787.7 89.0	2,095.8 104.4	2,679.2 133.4	2,830.0 140.9	2,083.0 103.7
Israel	... ...	... ...	2.5 0.1	70.2 3.5	1.0 ...	0.3 ...	0.2 ...	0.1 ...	0.1 ...	0.1 ...	1.0 ...	0.3 ...	0.3 ...	0.3
Jordan	... ...	... ...	... ...	... ...	... ...	... ...	... ...	... ...	... ...	... ...	4.0 0.2	0.5 ...	0.3 ...	0.4 ...
Kuwait	... ...	344.4 17.2	1,628.2 81.1	2,734.5 136.2	1,382.0 68.8	675.0 33.6	912.0 45.4	925.0 46.1	823.3 41.0	1,202.0 59.9	1,096.8 54.6	1,254.2 62.5	1,542.6 76.8	1,080.0 53.8
Neutral Zone	... ...	... ...	136.2 6.8	500.6 24.9	540.0 26.9	315.0 15.7	398.0 19.8	420.0 20.9	357.8 17.8	325.7 16.2	399.2 19.9	316.3 15.8	396.6 19.8	315.0 15.7
Oman	... ...	... ...	... ...	332.4 16.6	283.0 14.1	328.0 16.3	378.0 18.8	404.0 20.1	484.3 24.1	540.8 26.9	565.0 28.1	596.7 29.7	622.7 31.0	658.0 32.8
Qatar	... ...	33.6 1.7	175.1 8.7	362.4 18.0	472.0 23.5	340.0 16.9	270.0 13.4	395.0 19.7	297.0 14.8	332.3 16.5	284.4 14.2	349.2 17.4	394.6 19.7	387.0 19.3
Ras Al Khaimah	... ...	... ...	... ...	... ...	... ...	... ...	... ...	5.8 0.3	9.1 0.5	11.0 0.5	10.0 0.5	10.0 0.5	10.0 0.5	10.0 0.5
Saudi Arabia	13.9 0.7	546.7 27.2	1,247.1 62.1	3,548.9 176.7	9,630.0 479.6	6,484.0 322.9	4,872.0 242.6	4,545.0 226.3	3,295.3 164.1	4,719.7 235.0	4,054.2 201.9	4,708.3 234.5	4,935.6 245.8	6,215.0 309.5
Sharjah	... ...	... ...	... ...	... ...	10.0 0.5	7.0 0.3	35.0 1.7	62.0 3.1	65.1 3.3	65.0 3.2	56.9 3.3	65.0 3.2	65.0 3.2	35.0 1.7
Syria	... ...	... ...	... ...	83.1 4.1	165.0 8.2	175.0 8.7	165.0 8.2	161.0 8.0	161.7 8.1	185.0 9.2	231.7 11.5	273.3 13.6	300.6 15.0	385.0 19.2
Turkey	... ...	0.3 ...	7.0 0.3	67.9 3.4	44.0 2.2	45.0 2.2	45.0 2.2	41.0 2.0	41.5 2.1	46.8 2.3	52.0 2.6	50.0 2.5	55.5 2.8	70.0 3.5
Yemen	... ...	... ...	... ...	... ...	... ...	... ...	... ...	... ...	... ...	10.0 0.5	10.0 0.5	172.4 8.6	186.6 9.3	179.0 8.9
Total	**275.1** **13.7**	**1,755.7** **87.5**	**5,313.0** **264.5**	**13,347.8** **664.7**	**18,379.0** **915.3**	**12,464.3** **620.5**	**11,711.2** **583.0**	**11,457.9** **570.6**	**10,307.0** **513.4**	**12,378.4** **616.1**	**12,596.5** **627.8**	**14,093.1** **701.8**	**16,086.5** **801.1**	**16,635.7** **828.5**

EUROPE

Upper figures = 1,000 b/d
Lower figures = million t/y

	1940	1950	1960	1970	1980	1982	1983	1984	1985	1986	1987	1988	1989	1990
Austria	7.7 0.4	27.9 1.4	45.4 2.3	53.3 2.7	29.0 1.4	25.0 1.2	24.0 1.2	23.0 1.1	21.7 1.1	22.2 1.1	21.6 1.1	23.2 1.2	23.3 1.2	24.0 1.2
Denmark	...	...	...	...	6.0 0.3	38.0 1.9	46.0 2.3	45.0 2.2	58.0 2.9	74.7 3.7	94.0 4.7	95.5 4.8	111.0 5.5	118.0 5.9
France	1.4 0.1	2.5 0.1	38.6 1.9	45.8 2.3	26.0 1.3	33.0 1.6	32.0 1.6	35.0 1.7	49.0 2.4	59.0 2.9	63.5 3.2	68.7 3.4	65.3 3.3	62.0 3.1
Germany	20.1 1.0	23.2 1.2	108.3 5.4	148.4 7.4	100.0 5.0	94.0 4.7	91.0 4.5	89.0 4.4	90.5 4.5	90.0 4.5	83.8 4.2	85.9 4.3	81.7 4.1	78.0 3.9
Greece	... ...	... ...	... ...	... ...	... ...	21.0 1.0	25.0 1.2	27.0 1.3	26.4 1.3	26.4 1.3	24.4 1.2	21.8 1.1	17.0 0.8	15.0 0.7
Italy	0.2	0.2 ...	37.5 1.9	26.3 1.3	39.0 1.9	28.0 1.4	37.0 1.8	45.0 2.2	41.7 2.1	49.0 2.4	50.0 2.5	92.9 4.6	94.7 4.7	97.0 4.8
Netherlands	... ...	13.4 0.7	36.0 1.8	35.8 1.8	25.0 1.2	28.0 1.4	42.0 2.1	61.0 3.0	69.0 3.4	79.0 3.9	91.3 4.5	83.7 4.2	87.0 4.3	71.0 3.5
Norway	...	... ...	... ...	... ...	528.0 26.3	488.0 24.3	600.0 29.9	688.0 34.3	771.0 38.4	823.3 41.0	973.3 48.5	1,069.1 53.2	1,469.8 73.2	1,574.0 78.4
Spain	... ...	... ...	... ...	3.1 0.2	32.0 1.6	30.0 1.5	59.0 2.9	45.0 2.2	45.3 2.3	37.2 1.9	32.8 1.6	30.4 1.5	18.0 0.9	14.3 0.7
United Kingdom	0.3 ...	0.9 ...	1.7 0.1	1.7 0.1	1,619.0 80.6	2,050.0 102.1	2,260.0 112.5	2,452.0 122.1	2,519.8 125.5	2,602.0 129.6	2,445.9 121.8	2,376.3 118.3	1,743.0 86.8	1,860.0 92.6
Total	**29.7** **1.5**	**68.1** **3.4**	**267.5** **13.4**	**314.4** **15.8**	**2,404.0** **119.6**	**2,835.0** **141.1**	**3,216.0** **160.0**	**3,510.0** **174.5**	**3,692.4** **183.9**	**3,862.8** **192.3**	**3,880.6** **193.3**	**3,947.5** **196.6**	**3,710.8** **184.8**	**3,913.3** **194.8**

AFRICA

Upper figures = 1,000 b/d
Lower figures = million t/y

	1940	1950	[illegible]60	1970	1980	1982	1983	1984	1985	1986	1987	1988	1989	1990
Algeria	... ...	... ...	[illegible] [illegible].1	[illegible]9.1 51.2	1,016.0 50.6	750.0 37.4	686.6 34.2	608.0 30.3	643.3 32.0	600.7 29.9	647.9 32.3	666.8 33.2	698.0 34.8	797.0 39.7
Angola (inc. Cabinda)	... ...	... ...	1.3 0.1	13.7 0.7	150.0 7.5	122.0 6.1	174.0 8.7	207.0 10.3	228.5 11.4	280.7 14.0	341.3 17.0	449.3 22.4	454.7 22.6	480.0 23.9
Cameroon	... ...	... ...	... ...	... ...	58.0 2.9	109.0 5.4	114.0 5.7	125.0 6.2	133.5 6.6	180.0 9.0	170.0 8.5	170.0 8.5	172.7 8.6	164.0 8.2
Congo	... ...	... ...	... ...	... ...	56.0 2.8	87.0 4.3	95.0 4.7	118.0 5.9	115.1 5.7	115.0 5.7	118.0 5.9	134.8 6.7	150.0 7.5	161.0 8.0
Egypt	18.1 0.9	44.9 2.2	61.6 3.1	327.3 16.3	596.0 29.7	667.0 33.2	690.0 34.4	790.0 39.3	885.8 44.1	773.7 38.5	899.3 44.8	851.3 42.4	854.3 42.5	873.0 43.5
Gabon	... ...	... ...	16.1 0.8	108.8 5.4	180.0 9.0	130.0 6.5	150.0 7.5	150.0 7.5	150.0 7.5	146.2 7.3	155.8 7.8	175.0 8.7	197.3 9.8	269.0 13.4
Ivory Coast	... ...	... ...	... ...	... ...	... ...	9.0 0.4	24.0 1.2	22.0 1.1	28.0 1.4	20.0 1.0	16.0 0.8	12.9 0.6	2.0 0.1	2.1 0.1
Libya	... ...	... ...	... ...	3,318.0 165.2	1,785.0 88.9	1,127.0 56.1	1,020.0 50.8	1,090.0 54.3	1,045.3 52.1	1,030.7 51.3	1,019.7 50.8	1,012.5 50.4	1,100.6 54.8	1,369.0 68.2
Nigeria	... ...	... ...	17.3 0.9	1,083.3 53.9	2,057.0 102.4	1,324.0 65.9	1,232.0 61.4	1,414.0 70.4	1,445.5 72.0	1,464.0 72.9	1,238.6 61.7	1,358.3 67.6	1,605.3 79.9	1,808.0 90.0
Tunisia	... ...	... ...	3.0 0.1	87.7 4.4	110.0 5.5	106.0 5.3	115.0 5.7	114.0 5.7	125.0 6.2	106.0 5.3	104.3 5.2	102.8 5.1	102.0 5.1	93.0 4.6
Zaire	... ...	... ...	... ...	... ...	20.0 1.0	22.0 1.1	26.0 1.3	27.0 1.3	30.5 1.5	32.1 1.6	31.8 1.6	29.5 1.5	27.5 1.4	28.0 1.4
Others	... ...	0.8 ...	3.0 0.1	1.5 0.1	4.0 0.2	1.7 0.1	6.6 0.3	7.7 0.4	8.9 0.4	7.6 0.4	12.3 0.6	5.0 0.2	4.8 0.2	4.3 0.2
Total	**18.1** **0.9**	**45.7** **2.2**	**285.0** **14.2**	**5,969.4** **297.2**	**6,032.0** **300.5**	**4,454.7** **221.8**	**4,333.2** **215.9**	**4,672.7** **232.7**	**4,839.4** **240.9**	**4,756.7** **236.9**	**4,755.0** **237.0**	**4,968.2** **247.3**	**5,369.2** **267.3**	**6,048.4** **301.2**

DRILLING at Egypt's Ras Budran field. (Photo couresty OPEC Bulletin).

ASIA-PACIFIC

Upper figures = 1,000 b/d
Lower figures = million t/y

	1940	1950	1960	1970	1980	1982	1983	1984	1985	1986	1987	1988	1989	1990
Australia	... ...	... ...	... ...	175.6 8.7	379.0 18.9	353.0 17.6	405.0 20.2	481.0 24.0	556.0 27.7	472.0 23.5	566.1 28.2	552.3 27.5	488.8 24.3	582.0 29.0
Bangladesh	... ...	... ...	... ...	... ...	... ...	... ...	... ...	... ...	... ...	... ...	**0.5** ...	**0.9** ...	**0.9** ...	**0.9** ...
Brunei	19.3 1.0	84.8 4.2	92.9 4.6	148.0 7.4	230.0 11.5	155.0 7.7	155.0 7.7	160.0 8.0	149.5 7.4	170.0 8.5	133.7 6.7	138.3 6.9	143.3 7.1	143.0 7.1
China	... ...	**4.0** **0.2**	**100.0** **5.0**	**500.0** **24.9**	**2,119.0** **105.5**	**2,042.0** **101.7**	**2,120.0** **105.6**	**2,250.0** **112.1**	**2,496.0** **124.3**	**2,620.0** **130.5**	**2,700.0** **134.5**	**2,733.0** **136.1**	**2,770.0** **137.9**	**2,755.0** **137.2**
China, Taiwan	... ...	... ...	0.4 ...	1.8 0.1	5.0 0.2	3.0 0.1	2.3 0.1	2.6 0.1	2.7 0.1	1.9 0.1	2.6 0.1	2.6 0.1	2.6 0.1	2.5 0.1
India	**3.9** **0.2**	**5.1** **0.3**	**9.0** **0.4**	**138.6** **6.9**	**182.0** **9.1**	**384.0** **19.1**	**390.0** **19.4**	**543.0** **27.0**	**614.0** **30.6**	**622.7** **31.0**	**608.7** **30.3**	**631.8** **31.5**	**673.3** **33.5**	**679.0** **33.8**
Indonesia	169.4 8.4	132.6 6.6	411.2 2.05	853.6 42.5	1,576.0 78.5	1,341.0 66.8	1,292.0 64.3	1,332.0 66.3	1,219.5 60.7	1,243.8 61.9	1,185.8 59.1	1,137.5 56.6	1,208.6 60.2	1,274.0 63.4
Japan	**7.2** **0.4**	**5.6** **0.3**	**10.2** **0.5**	**16.3** **0.8**	**10.0** **0.5**	**6.0** **0.3**	**6.9** **0.3**	**6.4** **0.3**	**10.0** **0.5**	**12.8** **0.6**	**12.1** **0.6**	**12.3** **0.6**	**11.3** **0.6**	**10.5** **0.5**
Malaysia	... ...	... ...	... ...	... ...	288.0 14.3	306.0 15.2	370.0 18.4	462.0 23.0	432.8 21.6	503.3 25.1	467.4 23.3	540.0 26.9	557.3 27.8	605.0 30.1
Myanmar (Burma)	**21.1** **1.1**	**1.5** **0.1**	**11.1** **0.6**	**16.4** **0.8**	**30.0** **1.5**	**30.0** **1.5**	**30.0** **1.5**	**30.0** **1.5**	**30.0** **1.5**	**30.0** **1.5**	**24.0** **1.2**	**15.0** **0.7**	**12.0** **0.6**	**13.0** **0.6**
New Zealand	... ...	... ...	... ...	... ...	7.0 0.3	15.0 0.7	15.0 0.7	18.0 0.9	18.0 0.9	29.3 1.5	28.3 1.4	28.0 1.4	28.0 1.4	39.0 1.9
Pakistan	**2.4** **0.1**	**3.5** **0.2**	**7.2** **0.4**	**9.9** **0.5**	**10.0** **0.5**	**12.0** **0.6**	**13.0** **0.6**	**18.0** **0.9**	**34.3** **1.7**	**41.0** **2.0**	**41.6** **2.1**	**47.0** **2.3**	**45.0** **2.2**	**60.0** **3.0**
Papua New Guinea	... ...	4.8 0.2	4.2 0.2	... ...	... ...	... ...	... ...	... ...	... ...	... ...	... ...	... ...	... ...	...
Philippines	... ...	... ...	... ...	... ...	**15.0** **0.7**	**7.0** **0.3**	**15.0** **0.7**	**12.0** **0.6**	**9.3** **0.5**	**6.3** **0.3**	**5.1** **0.3**	**9.2** **0.5**	**4.0** **0.2**	**5.0** **0.2**
Thailand	... ...	... ...	... ...	0.4 ...	... ...	6.0 0.3	11.0 0.5	19.0 0.9	34.3 1.7	35.6 1.8	31.3 1.6	38.4 1.9	39.0 1.9	41.0 2.0
Viet Nam*	... ...	... ...	... ...	... ...	... ...	... ...	... ...	... ...	... ...	... ...	... ...	... ...	... ...	**40.0** **2.0**
Total	**223.3** **11.2**	**241.9** **12.1**	**646.2** **32.2**	**1,860.6** **92.6**	**4,851.0** **241.5**	**4,660.0** **231.9**	**4,825.2** **240.0**	**5,334.0** **265.6**	**5,606.4** **279.2**	**5,788.7** **288.3**	**5,807.2** **289.4**	**5,886.3** **293.0**	**5,984.1** **297.8**	**6,249.9** **310.9**

*Prior to 1990, included in other Eastern Europe - U.S.S.R.

LATIN AMERICA

Upper figures = 1,000 b/d
Lower figures = million t/y

	1940	1950	1960	1970	1980	1982	1983	1984	1985	1986	1987	1988	1989	1990
Argentina	56.3 2.8	64.0 3.2	171.9 8.6	382.9 19.1	487.0 24.3	483.0 24.1	481.0 24.0	467.0 23.3	447.5 22.3	430.2 21.4	419.1 20.9	449.6 22.4	459.0 22.9	473.0 23.6
Bolivia	0.8 ...	1.7 0.1	9.8 0.5	16.3 0.8	30.0 1.5	24.0 1.2	22.0 1.1	20.0 1.0	20.0 1.0	18.7 0.9	18.5 0.9	18.8 0.9	20.3 1.0	19.2 1.0
Brazil	... ...	0.9 ...	80.9 4.0	160.5 8.0	182.0 9.1	252.0 12.5	315.0 15.7	437.0 21.8	540.5 26.9	578.0 28.8	562.8 28.0	555.6 27.7	597.1 29.7	633.0 31.5
Chile	... ...	1.7 0.1	19.8 1.0	34.6 1.7	29.0 1.4	41.0 2.0	39.0 1.9	38.0 1.9	32.5 1.6	34.4 1.7	28.3 1.4	24.8 1.2	23.7 1.2	20.3 1.0
Colombia	69.9 3.5	93.3 4.6	152.7 7.6	214.0 10.7	125.0 6.2	140.0 7.0	155.0 7.7	165.0 8.2	178.8 8.9	324.2 16.1	387.8 19.3	346.7 17.3	405.0 20.2	445.0 22.2
Cuba*	... ...	... ...	... ...	... ...	... ...	... ...	... ...	... ...	... ...	... ...	... ...	... ...	... ...	15.0 0.7
Ecuador	6.4 0.3	7.2 0.4	7.7 0.4	4.1 0.2	222.0 11.1	215.0 10.7	236.0 11.8	254.0 12.6	273.3 13.6	270.1 13.5	157.2 7.8	310.1 15.4	286.6 14.3	287.0 14.3
Guatemala	... ...	... ...	... ...	... ...	5.0 0.2	6.4 0.3	7.5 0.4	5.2 0.3	3.1 0.2	4.9 0.2	3.9 0.2	3.7 0.2	3.7 0.2	4.0 0.2
Mexico	120.3 6.0	198.5 9.9	270.6 13.5	430.2 21.4	1,936.0 96.4	2,734.0 136.2	2,702.0 134.6	2,743.0 136.6	2,797.0 139.3	2,468.0 122.9	2,537.8 126.4	2,527.3 125.9	2,618.0 130.4	2,633.0 131.1
Peru	33.2 1.7	41.1 2.0	52.6 2.6	72.2 3.6	191.0 9.5	198.0 9.9	171.0 8.5	201.0 10.0	189.0 9.4	179.0 8.9	166.7 8.3	141.7 7.1	129.0 6.4	132.0 6.6
Trinidad & Tobogo	60.9 3.0	56.5 2.8	115.7 5.8	139.8 7.0	211.0 10.5	182.0 9.1	158.0 7.9	169.0 8.4	179.0 8.9	167.9 8.4	163.1 8.1	149.3 7.4	153.7 7.7	151.0 7.5
Venezuela	507.0 25.2	1,498.0 74.6	2,846.1 141.7	3,708.0 184.7	2,167.0 107.9	1,826.0 90.9	1,791.0 89.2	1,724.0 85.9	1,669.0 83.1	1,664.9 82.9	1,591.9 79.3	1,658.0 82.6	1,731.6 86.2	2,118.0 105.5
Others	... ...	... ...	... ...	... ...	... ...	0.6 ...	0.5 ...	2.2 0.1	2.9 0.1	3.6 0.2	3.6 0.2	3.7 0.2	4.9 0.2	5.2 0.3
Total	854.8 42.5	1,962.9 97.7	3,727.8 185.7	5,162.6 257.2	5,585.0 278.1	6,102.0 303.9	6,078.0 302.8	6,225.4 310.1	6,332.8 315.3	6,143.9 305.9	6,040.7 300.8	6,189.3 308.3	6,432.8 320.4	6,936.7 345.5
World Total, excl. E. Europe-U.S.S.R.	5,131.9 255.6	9,561.0 476.2	17,819.7 887.5	37,048.4 1,870.0	47,232.0 2,352.0	40,404.0 2,011.6	40,228.6 2,002.9	41,380.0 2,060.5	41,149.8 2,049.3	43,192.8 2,150.7	42,874.0 2,135.6	44,854.9 2,233.6	46,846.8 2,332.7	48,511.0 2,415.6

*Prior to 1990, included in other Eastern Europe - U.S.S.R.

EASTERN EUROPE — U.S.S.R.

Upper figures = 1,000 b/d
Lower figures = million t/y

	1940	1950	1960	1970	1980	1982	1983	1984	1985	1986	1987	1988	1989	1990
Bulgaria	... ...	... ...	4.0 0.2	6.7 0.3	6.0 0.3	3.0 0.1	3.0 0.1	3.0 0.1	3.0 0.1	3.0 0.1	6.0 0.3	5.0 0.2	5.0 0.2	5.0 0.2
Czechoslovakia	... ...	0.8 ...	2.7 0.1	4.1 0.2	1.9 0.1	2.0 0.1	2.0 0.1	2.0 0.1	2.0 0.1	2.0 0.1	2.0 0.1	3.0 0.1	3.0 0.1	3.0 0.1
Hungary	... ...	10.1 0.5	24.3 1.2	38.7 1.9	40.6 2.0	41.0 2.0	40.0 2.0	40.0 2.0	40.0 2.0	40.0 2.0	40.0 2.0	40.0 2.0	39.0 1.9	40.0 2.0
Poland	... ...	3.3 0.2	3.9 0.2	8.5 0.4	6.6 0.3	4.0 0.2	5.0 0.2	5.0 0.2	5.0 0.2	4.0 0.2	4.0 0.2	4.0 0.2	3.0 0.1	3.0 0.1
Romania	... ...	87.7 4.4	231.0 11.5	268.6 13.4	230.9 11.5	234.0 11.7	240.0 12.0	229.0 11.4	226.0 11.3	220.0 11.0	215.0 10.7	188.0 9.4	180.0 9.0	160.0 8.0
U.S.S.R.*	624.9 31.1	760.6 37.9	2,969.1 147.9	7,089.2 353.0	12,031.0 599.1	12,260.0 610.5	12,320.0 613.5	12,260.0 610.5	11,900.0 592.6	12,300.0 612.5	12,480.0 621.5	12,452.0 620.1	12,140.0 604.6	11,500.0 572.7
Yugoslavia	0.3 ...	2.1 0.1	18.8 0.9	57.8 2.9	84.5 4.2	87.0 4.3	82.0 4.1	80.0 4.0	81.0 4.0	83.0 4.1	84.0 4.2	73.0 3.6	70.0 3.5	65.0 3.2
Others	... ...	2.7 0.1	14.9 0.7	37.1 1.8	50.0 2.5	81.0 4.0	86.0 4.3	96.0 4.8	86.0 4.3	77.0 3.8	80.0 4.0	85.0 4.2	86.0 4.3	30.0 1.5
Total	625.2 31.1	867.3 43.2	3,268.7 162.7	7,510.7 373.9	12,451.5 620.0	12,712.0 632.9	12,778.0 636.3	12,715.0 633.1	12,343.0 614.6	12,729.0 633.8	12,911.0 643.0	12,850.0 639.8	12,526.0 623.7	11,806.0 587.8
***Includes gas liquids**														
World Total	5,757.1 286.7	10,428.3 519.4	21,088.4 1,050.2	45,059.1 2,243.9	59,683.5 2,972.0	53,116.0 2,644.5	53,006.6 2,639.2	54,095.0 2,693.6	53,492.8 2,663.9	55,921.8 2,784.5	55,785.0 2,778.6	57,704.9 2,873.4	59,372.8 2,956.4	60,317.0 3,003.4

Worldwide oil consumption

Upper figures = 1,000 b/d
Lower figures = million t/y

	1987	1988	1989
U.S.A.	16,035 767.3	16,525 793.4	16,585 792.6
Canada	1,515 70.2	1,590 73.7	1,660 76.8
Total North America	17,550 837.5	18,115 867.1	18,245 869.4
Latin America	4,985 236.4	5,070 240.3	5,265 248.5
Total Western Hemisphere	**22,535** **1,073.9**	**23,185** **1,107.4**	**23,510** **1,117.9**
Austria	220 10.7	215 10.6	215 10.4
Belgium and Luxembourg	490 23.7	500 24.4	480 23.1
Denmark	200 9.8	195 9.5	185 9.1
Finland	230 11.2	230 11.0	230 11.0
France	1,845 [illegible]	1,830 88.0	1,875 88.4
Greece	270 13.2	280 13.7	275 13.6
Ireland	85 4.1	80 3.9	85 4.0
Italy	1,850 90.1	1,880 91.7	1,940 94.3
Netherlands	705 32.4	740 34.5	740 34.3
Norway	215 9.7	205 9.2	195 8.9
Portugal	190 9.9	185 8.7	195 9.3
Spain	945 43.8	970 44.7	1,010 46.6
Sweden	355 17.1	340 16.5	325 15.4
Switzerland	265 12.4	265 12.4	255 11.9
Turkey	435 21.0	465 22.3	465 22.1

	1987	1988	1989
United Kingdom	1,610 75.2	1,690 79.2	1,730 81.2
West Germany	2,445 115.2	2,445 115.2	2,295 107.1
Other	55 2.8	60 3.1	65 3.1
Total Western Europe	12,410 597.7	12,575 [illegible]	12,580 [illegible]
U.S.S.R.	8,985 444.2	8,885 439.1	8,795 434.7
Eastern Europe	2,165 105.5	2,170 [illegible]	2,150 [illegible]
Middle East	2,705 130.1	2,805 135.1	2,920 140.3
Africa	1,770 84.6	1,820 [illegible]	[illegible]
South Asia	1,245 60.4	1,360 65.8	1,450 69.7
Other Asia	2,080 101.2	[illegible]	[illegible]
China	2,110 105.3	2,210 110.2	2,360 117.1
Japan	4,500 209.2	[illegible]	[illegible]
South Korea	605 29.0	720 34.7	825 39.5
Australasia	750 [illegible]	[illegible]	[illegible]
Total Eastern Hemisphere	**39,305** **1,890.4**	**40,380** **1,945.4**	**41,225** **1,979.9**
World Total	61,840 2,964.3	63,565 [illegible]	[illegible]
Of which OECD and LDCs*	48,205 2,290.9	49,920 2,378.3	51,020 2,420.7

Organisation for Cooperation and Development and lesser developed countries.

Source: British Petroleum Co. plc

South Asia—Afghanistan, Bangladesh, India, Myanmar, Nepal, Pakistan, Sri Lanka, Other Asia—Brunei, Cambodia, Hong Kong, Indonesia, Laos, Malaysia, Mongolia, North Korea, Papua New Guinea, Philippines, Singapore, SW Pacific Islands, Taiwan, Thailand, Australasia—Australia, New Zealand.

Worldwide refining capacity

EUROPE

Upper figures = 1,000 b/d
Lower figures = million t/y

	1940	1950	1960	1970	1980	1983	1984	1985	1986	1987	1988	1989	1990	1991
Austria	... ...	26 1.3	47 2.3	94 4.7	280 13.9	269 13.4	268 13.3	273 13.6	204 10.2	204 10.2	204 10.2	204 10.2	204 10.2	204 10.2
Belgium	12 0.6	16 0.8	171 8.5	669 33.3	1,064 53.0	693 34.5	694 34.6	693 34.5	652 32.5	648 32.3	631 31.4	631 31.4	614 30.6	602 30.0
Cyprus	... ...	... ...	... ...	... ...	16 0.8	16 0.8	15 0.7	16 0.8	16 0.8	16 0.8	16 0.8	17 0.8	18 0.9	19 0.9
Denmark	1 ...	1 ...	1 ...	186 9.3	214 10.7	215 10.7	174 8.7	176 8.8	166 8.3	166 8.3	177 8.8	177 8.8	187 9.3	186 9.3
Finland	... ...	... ...	25 1.2	174 8.6	336 16.7	299 14.9	299 14.9	299 14.9	241 12.0	241 12.0	241 12.0	241 12.0	241 12.0	241 12.0
France	152 7.6	306 15.2	769 38.3	2,317 115.4	3,385 168.6	2,871 143.0	2,670 133.0	2,386 118.8	1,947 97.0	1,834 91.3	1,941 96.7	1,876 93.4	1,820 90.6	1,816 90.4
Germany	48 2.4	81 4.0	573 28.5	2,359 117.5	2,986 148.7	2,471 123.1	2,386 118.8	2,172 108.2	1,933 96.3	1,720 85.7	1,648 82.1	1,518 75.6	1,507 75.0	2,065 102.8
Greece	... ...	... ...	30 1.5	102 5.1	431 21.5	422 21.0	369 18.4	390 19.4	390 19.4	385 19.2	385 19.2	385 19.2	385 19.2	395 19.7
Ireland	11 0.5	... ...	40 2.0	55 2.7	56 2.8	56 2.8	56 2.8	56 2.8	56 2.8	56 2.8	56 2.8	56 2.8	56 2.8	56 2.8
Italy	41 2.0	107 5.3	773 38.5	2,963 147.5	4,131 205.7	3,283 163.5	3,050 151.9	3,095 154.1	2,738 136.4	2,679 133.4	2,563 127.6	2,450 122.0	2,804 139.6	2,385 118.8
Netherlands	15 0.7	77 3.8	359 17.9	1,362 67.8	1,828 91.0	1,552 77.3	1,552 77.3	1,499 74.7	1,468 73.1	1,401 69.8	1,381 68.8	1,381 68.8	1,381 68.8	1,197 59.6
Norway	1 ...	1 ...	2 0.1	123 6.1	264 13.1	243 12.1	243 12.1	244 12.2	240 12.0	240 12.0	240 12.0	239 11.9	295 14.7	288 14.3
Portugal	4 0.2	8 0.4	23 1.1	37 1.8	378 18.8	365 18.2	282 14.0	290 14.4	296 14.7	294 14.6	294 14.6	313 15.6	313 15.6	294 14.6
Spain	11 0.5	17 0.8	146 7.2	685 34.1	1,455 72.5	1,522 75.8	1,493 74.4	1,492 74.4	1,367 68.1	1,305 65.0	1,305 65.0	1,285 64.0	1,293 64.4	1,321 65.8
Sweden	4 0.2	26 1.3	48 2.4	230 11.5	458 22.8	453 22.6	453 22.6	439 21.9	429 21.4	437 21.8	437 21.8	427 21.3	428 21.3	428 21.3
Switzerland	... ...	... ...	... ...	106 5.3	137 6.8	137 6.8	137 6.8	127 6.3	137 6.8	65 3.2	132 6.6	132 6.6	132 6.6	132 6.6
United Kingdom	133 6.6	197 9.8	963 47.9	2,301 114.6	2,527 125.8	2,260 112.5	2,092 104.2	2,007 99.9	1,792 89.2	1,780 88.6	1,803 89.8	1,803 89.8	1,831 91.2	1,867 93.0
Yugoslavia	5 0.2	8 0.4	10 0.5	179 8.9	296 14.7	297 14.8	297 14.8	297 14.8	302 15.0	483 24.1	608 30.3	609 30.3	609 30.3	609 30.3
Total Europe	**438 21.5**	**871 43.1**	**3,980 198.1**	**13,942 694.4**	**20,242 1,007.9**	**17,424 867.8**	**16,530 823.3**	**15,952 794.5**	**14,374 716.0**	**13,954 695.1**	**14,062 700.5**	**13,744 684.5**	**14,118 703.1**	**14,105 702.4**

NORTH AMERICA

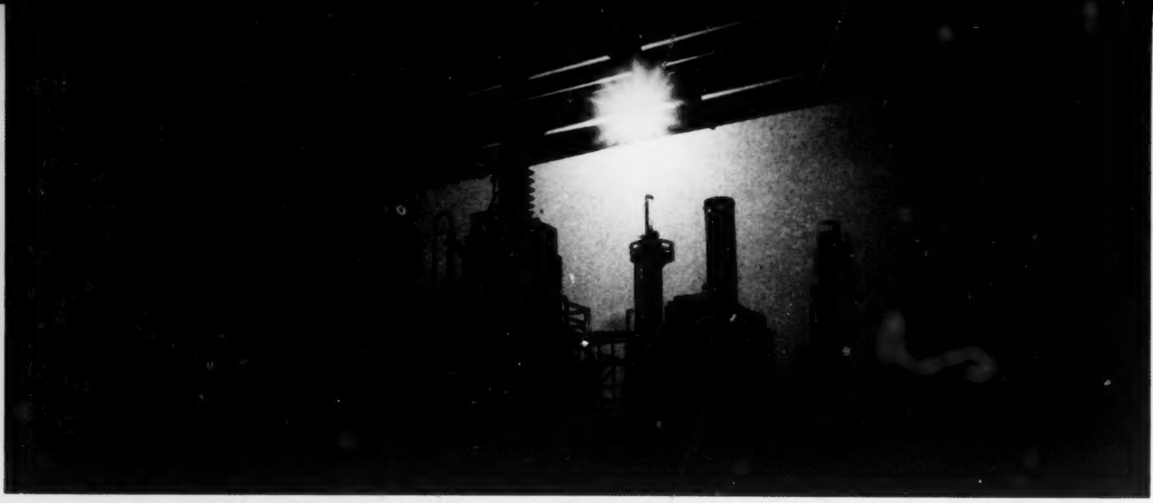
Upper figures = 1,000 b/d
Lower figures = million t/y

	1940	1950	1960	1970	1980	1983	1984	1985	1986	1987	1988	1989	1990	1991
Canada	203 10.1	329 16.4	920 45.8	1,400 69.7	2,222 110.7	2,020 100.6	1,807 90.0	1,869 93.1	1,856 92.4	1,760 87.6	1,869 93.1	1,856 92.4	1,852 92.2	1,882 93.7
United States	4,460 222.1	6,696 333.5	10,250 510.5	12,600 627.5	17,720 882.5	16,800 836.6	15,930 793.3	15,400 766.9	15,182 756.1	15,258 759.8	15,288 761.3	15,557 774.7	16,244 809.0	15,559 774.8
Total	**4,663 232.2**	**7,025 349.9**	**11,170 556.3**	**14,000 697.2**	**19,942 993.2**	**18,820 937.2**	**17,737 883.3**	**17,269 860.0**	**17,038 848.5**	**17,018 847.4**	**17,157 854.4**	**17,413 867.1**	**18,096 901.2**	**17,441 868.5**

LATIN AMERICA

Upper figures = 1,000 b/d
Lower figures = million t/y

	1940	1950	1960	1970	1980	1983	1984	1985	1986	1987	1988	1989	1990	1991
Argentina	103 5.1	152 7.6	238 11.9	457 22.8	676 33.7	676 33.7	678 33.8	678 33.8	667 33.2	670 33.4	690 34.4	690 34.4	689 34.3	696 34.7
Bahamas	... ...	... ...	... ...	... ...	500 24.9	500 24.9	500 24.9	350 17.4	... ...	... ...	... ...	... ...	... ...	... ...
Barbados	... ...	... ...	... ...	3 0.1	3 0.1	3 0.1	3 0.1	3 0.1	3 0.1	3 0.1	3 0.1	3 0.1	3 0.1	3 0.1
Bolivia	1 ...	7 0.3	12 0.6	12 0.6	74 3.7	61 3.0	47 2.3	47 2.3	47 2.3	47 2.3	47 2.3	58 2.9	58 2.9	45 2.2
Brazil	4 0.2	12 0.6	156 7.8	502 25.0	1,205 60.0	1,219 60.7	1,301 64.8	1,305 65.0	1,305 65.0	1,321 65.8	1,407 70.1	1,407 70.1	1,397 69.6	1,412 70.3
Chile	1 ...	4 0.2	24 1.2	91 4.5	139 6.9	141 7.0	141 7.0	141 7.0	141 7.0	150 7.5	141 7.0	147 7.3	147 7.3	146 7.3
Colombia	15 0.7	24 1.2	51 2.5	137 6.8	193 9.6	214 10.7	211 10.5	211 10.5	211 10.5	226 11.3	226 11.3	227 11.3	227 11.3	247 12.3
Costa Rica	... ...	... ...	... ...	8 0.4	11 0.5	16 0.8	17 0.8	16 0.8	15 0.7	16 0.8	16 0.8	16 0.8	16 0.8	15 0.7
Cuba	4 0.2	7 0.3	87 4.3	93 4.6	160 8.0	160 8.0	160 8.0	160 8.0	160 8.0	160 8.0	160 8.0	160 8.0	160 8.0	280 13.9
Ecuador	2 0.1	5 0.2	7 0.4	33 1.6	86 4.3	79 3.9	84 4.2	82 4.1	88 4.4	88 4.4	122 6.1	123 6.1	145 7.2	142 7.1
El Salvador	... ...	... ...	... ...	14 0.7	16 0.8	16 0.8	16 0.8	16 0.8	16 0.8	17 0.8	17 0.8	17 0.8	17 0.8	16 0.8
Guatemala	... ...	... ...	... ...	21 1.0	16 0.8	16 0.8	16 0.8	16 0.8	16 0.8	16 0.8	16 0.8	16 0.8	16 0.8	16 0.8
Honduras	... ...	... ...	... ...	10 0.5	14 0.7	14 0.7	14 0.7	14 0.7	14 0.7	14 0.7	14 0.7	14 0.7	14 0.7	14 0.7
Jamaica	... ...	... ...	... ...	32 1.6	34 1.7	36 1.8	36 1.8	36 1.8	36 1.8	36 1.8	36 1.8	34 1.7	34 1.7	34 1.7
Mexico	98 4.9	160 8.0	357 17.8	495 24.6	1,394 69.4	1,289 64.2	1,269 63.2	1,269 63.2	1,269 63.2	1,349 67.2	1,354 67.4	1,354 67.4	1,514 75.4	1,679 83.6
Netherlands Antilles	495 24.7	617 30.7	680 33.9	840 41.8	792 39.4	782 38.9	740 36.9	740 36.9	320 15.9	320 15.9	320 15.9	320 15.9	320 15.9	320 15.9
Nicaragua	... ...	... ...	... ...	22 1.1	14 0.7	14 0.7	15 0.7	15 0.7	15 0.7	15 0.7	15 0.7	15 0.7	15 0.7	16 0.8
Panama	... ...	... ...	... ...	78 3.9	100 5.0	100 5.0	100 5.0	100 5.0	100 5.0	100 5.0	100 5.0	100 5.0	100 5.0	100 5.0
Paraguay	... ...	... ...	... ...	5 0.2	7 0.3	8 0.4	8 0.4	8 0.4	8 0.4	8 0.4	8 0.4	8 0.4	8 0.4	8 0.4
Peru	22 1.1	35 1.7	49 2.5	92 4.6	170 8.5	168 8.4	169 8.4	176 8.8	176 8.8	176 8.8	182 9.1	172 8.6	172 8.6	189 9.4
Puerto Rico	... ...	... ...	84 4.2	155 7.7	284 14.1	123 6.1	121 6.0	121 6.0	121 6.0	121 6.0	123 6.1	123 6.1	123 6.1	125 6.2
Trinidad & Tobago	49 2.4	104 5.2	182 9.1	430 21.4	456 22.7	375 18.7	375 18.7	320 15.9	260 12.9	300 14.9	300 14.9	300 14.9	300 14.9	246 12.3
Uruguay	5 0.2	16 0.8	28 1.4	40 2.0	40 2.0	45 2.2	45 2.2	45 2.2	45 2.2	45 2.2	45 2.2	33 1.6	33 1.6	33 1.6
Venezuela	55 2.7	254 12.6	886 44.1	1,313 65.4	1,446 72.0	1,284 63.9	1,224 61.0	1,224 61.0	1,230 61.3	1,225 61.0	1,201 59.8	1,201 59.8	1,201 59.8	1,167 58.1
Virgin Islands	... ...	... ...	... ...	220 11.0	728 36.3	600 29.9	600 29.9	545 27.1	600 29.9	600 29.9	545 27.1	545 27.1	545 27.1	545 27.1
Others	... ...	... ...	... ...	11 0.5	62 3.1	77 3.8	55 2.7	57 2.8	57 2.8	57 2.8	61 3.0	60 3.0	61 3.0	60 3.0
Total	854 42.3	1,397 69.4	2,841 141.5	5,114 254.5	8,620 429.2	8,016 399.1	7,945 395.6	7,695 383.1	6,920 344.4	7,080 352.5	7,149 355.8	7,143 355.5	7,315 364.0	7,554 376.0



HERE IS a section of the Luanda refinery in Angola. (Photo courtesy OPEC Bulletin).

ASIA-PACIFIC

Upper figures = 1,000 b/d
Lower figures = million t/y

	1940	1950	1960	1970	1980	1983	1984	1985	1986	1987	1988	1989	1990	1991
Australia	4 0.2	14 0.7	237 11.8	594 29.6	725 36.1	716 35.7	722 36.0	697 34.7	623 31.0	626 31.2	637 31.7	644 32.1	675 33.6	706 35.2
Bangladesh	... ...	... ...	... ...	... ...	**31 1.5**	**31 1.5**	**22 1.1**	**31 1.5**	**31 1.5**	**31 1.5**	**31 1.5**	**31 1.5**	**31 1.5**	**31 1.5**
Brunei-Malaysia-Singapore	10 0.5	10 0.5	46 2.3	320 15.9	1,093 54.4	1,271 63.3	1,313 65.4	1,286 64.0	1,240 61.8	1,183 58.9	1,080 53.8	1,071 53.3	1,049 52.2	1,098 54.7
China	... ...	**8 0.4**	**98 4.9**	**300 14.9**	**1,600 79.7**	**2,000 99.6**	**2,050 102.1**	**2,150 107.1**	**2,150 107.1**	**2,200 109.6**	**2,200 109.6**	**2,200 109.6**	**2,200 109.6**	**2,200 109.6**
China, Taiwan	... ...	... ...	28 1.4	119 5.9	425 21.2	515 25.6	515 25.6	543 27.0	543 27.0	543 27.0	600 29.9	570 28.4	570 28.4	543 27.0
Guam*	... ...	... ...	... ...	... ...	**44 2.2**	**44 2.2**	**44 2.2**	**44 2.2**	... ...	... ...	... ...	... ...	... ...	... ...
India	10 0.5	6 0.3	112 5.6	446 22.2	557 27.7	753 37.5	779 38.8	705 35.1	867 43.2	991 49.4	1,059 52.7	1,051 52.3	1,080 53.8	1,122 55.9
Indonesia	**170 8.5**	**203 10.1**	**274 13.6**	**268 13.4**	**528 26.3**	**341 17.0**	**387 19.3**	**631 31.4**	**636 31.7**	**636 31.7**	**714 35.6**	**714 35.6**	**714 35.6**	**814 40.5**
Japan	53 2.6	34 1.7	640 31.9	3,140 156.4	5,509 274.3	5,548 276.3	5,020 250.0	4,813 239.7	4,613 229.7	4,790 238.5	4,567 227.4	4,363 217.3	4,198 209.1	4,383 218.3
Korea, North†	... ...	... ...	... ...	... ...	... ...	... ...	... ...	... ...	... ...	... ...	... ...	... ...	... ...	**42 2.1**
Korea, South	... ...	... ...	... ...	180 9.0	601 29.9	755 37.6	776 38.6	776 38.6	782 38.9	862 42.9	820 40.8	880 43.8	867 43.2	867 43.2
Myanmar (Burma)	... ...	... ...	**9 0.5**	**26 1.3**	**26 1.3**	**26 1.3**	**26 1.3**	**26 1.3**	**26 1.3**	**26 1.3**	**26 1.3**	**26 1.3**	**32 1.6**	**32 1.6**
New Zealand	... ...	... ...	... ...	66 3.3	74 3.7	74 3.7	74 3.7	53 2.6	53 2.6	54 2.7	82 4.1	88 4.4	95 4.7	95 4.7
Okinawa*	... ...	... ...	... ...	... ...	**198 9.9**	**183 9.1**	**153 7.6**	**153 7.6**	**110 5.5**	... ...	... ...	... ...	... ...	... ...
Pakistan	... ...	5 0.2	6 0.3	107 5.3	98 4.9	133 6.6	126 6.3	129 6.4	130 6.5	130 6.5	130 6.5	130 6.5	121 6.0	121 6.0
Philippines	... ...	... ...	**22 1.1**	**182 9.1**	**253 12.6**	**286 14.2**	**286 14.2**	**286 14.2**	**216 10.8**	**286 14.2**	**286 14.2**	**254 12.6**	**284 14.1**	**279 13.9**
Sri Lanka	... ...	... ...	... ...	44 2.2	38 1.9	50 2.5	50 2.5	50 2.5	50 2.5	50 2.5	50 2.5	50 2.5	50 2.5	50 2.5
Thailand	... ...	... ...	**1** ...	**62 3.1**	**186 9.3**	**176 8.8**	**176 8.8**	**172 8.6**	**192 9.6**	**192 9.6**	**192 9.6**	**191 9.5**	**215 10.7**	**221 11.0**
Others	27 1.3	4 0.2	... ...	12 0.6	... ...	... ...	... ...	... ...	... ...	... ...	... ...	... ...	... ...	... ...
Total	**274 13.6**	**284 14.1**	**1,472 73.3**	**5,886 292.1**	**11,986 596.9**	**12,902 642.5**	**12,519 623.5**	**12,545 624.5**	**12,262 610.7**	**12,600 627.5**	**12,474 621.2**	**12,263 610.7**	**12,181 606.6**	**12,604 627.7**

***Prior to 1980, included in others**

†Prior to 1981, included in other U.S.S.R.—Eastern Europe

AFRICA

Upper figures = 1,000 b/d
Lower figures = million t/y

	1940	1950	1960	1970	1980	1983	1984	1985	1986	1987	1988	1989	1990	1991
Algeria	... ...	... ...	... ...	48 2.4	122 6.1	137 6.8	137 6.8	464 23.1	465 23.2	465 23.2	465 23.2	465 23.2	465 23.2	465 23.2
Angola-Cabinda	**...** **...**	**...** **...**	**2** **0.1**	**14** **0.7**	**36** **1.8**	**32** **1.6**	**32** **1.6**	**32** **1.6**	**32** **1.6**	**32** **1.6**	**32** **1.6**	**32** **1.6**	**32** **1.6**	**38** **1.9**
Cameroon	... ...	... ...	... ...	... ...	... ...	43 2.1	41 2.0	43 2.1	43 2.1	43 2.1	43 2.1	42 2.1	43 2.1	42 2.1
Congo	**...** **...**	**...** **...**	**...** **...**	**14** **0.7**	**...** **...**	**...** **...**	**21** **1.0**	**21** **1.0**	**21** **1.0**	**21** **1.0**	**21** **1.0**	**21** **1.0**	**21** **1.0**	**21** **1.0**
Egypt	17 0.8	39 1.9	87 4.3	175 8.7	234 11.7	341 17.0	369 18.4	369 18.4	434 21.6	452 22.5	452 22.5	489 24.4	489 24.4	523 26.0
Ethiopia	**...** **...**	**...** **...**	**...** **...**	**11** **0.5**	**14** **0.7**	**14** **0.7**	**15** **0.7**	**14** **0.7**	**18** **0.9**	**18** **0.9**	**18** **0.9**	**18** **0.9**	**18** **0.9**	**18** **0.9**
Gabon	... ...	... ...	... ...	13 0.6	20 1.0	20 1.0	20 1.0	20 1.0	23 1.1	16 0.8	23 1.1	24 1.2	24 1.2	24 1.2
Ghana	**...** **...**	**...** **...**	**...** **...**	**29** **1.4**	**26** **1.3**	**27** **1.3**	**28** **1.4**	**28** **1.4**	**28** **1.4**	**28** **1.4**	**28** **1.4**	**27** **1.3**	**27** **1.3**	**27** **1.3**
Ivory Coast	... ...	... ...	... ...	19 0.9	50 2.5	90 4.5	90 4.5	90 4.5	90 4.5	73 3.6	60 3.0	60 3.0	69 3.4	69 3.4
Kenya	**...** **...**	**...** **...**	**...** **...**	**44** **2.2**	**95** **4.7**	**79** **3.9**	**79** **3.9**	**95** **4.7**	**95** **4.7**	**95** **4.7**	**90** **4.5**	**90** **4.5**	**95** **4.7**	**90** **4.5**
Liberia	... ...	... ...	... ...	10 0.5	15 0.7	15 0.7	15 0.7	15 0.7	15 0.7	15 0.7	15 0.7	15 0.7	15 0.7	15 0.7
Libya	**...** **...**	**...** **...**	**...** **...**	**10** **0.5**	**138** **6.9**	**130** **6.5**	**125** **6.2**	**330** **16.4**	**330** **16.4**	**329** **16.4**	**329** **16.4**	**329** **16.4**	**329** **16.4**	**348** **17.3**
Madagascar	... ...	... ...	... ...	13 0.6	11 0.5	16 0.8	16 0.8	16 0.8	16 0.8	16 0.8	16 0.8	16 0.8	16 0.8	16 0.8
Morocco	**...** **...**	**...** **...**	**2** **0.1**	**35** **1.7**	**72** **3.6**	**74** **3.7**	**74** **3.7**	**80** **4.0**	**81** **4.0**	**81** **4.0**	**155** **7.7**	**155** **7.7**	**155** **7.7**	**155** **7.7**
Mozambique	... ...	... ...	... ...	20 1.0	16 0.8	16 0.8	17 0.8	17 0.8	17 0.8	17 0.8	... ...	... ...	... ...	... ...
Nigeria	**...** **...**	**...** **...**	**...** **...**	**46** **2.3**	**160** **8.0**	**260** **12.9**	**247** **12.3**	**250** **12.5**	**250** **12.5**	**250** **12.5**	**270** **13.4**	**415** **20.7**	**433** **21.6**	**433** **21.6**
Senegal	... ...	... ...	... ...	13 0.6	20 1.0	18 0.9	18 0.9	30 1.5	30 1.5	30 1.5	30 1.5	30 1.5	24 1.2	24 1.2
Sierra Leone	**...** **...**	**...** **...**	**...** **...**	**10** **0.5**	**10** **0.5**	**10** **0.5**	**10** **0.5**	**10** **0.5**	**10** **0.5**	**10** **0.5**	**10** **0.5**	**10** **0.5**	**10** **0.5**	**10** **0.5**
South Africa	1 ...	... ...	25 1.2	184 9.2	478 23.8	424 21.1	389 19.4	389 19.4	389 19.4	389 19.4	434 21.6	434 21.6	434 21.6	431 21.5
Sudan	**...** **...**	**...** **...**	**...** **...**	**21** **1.0**	**26** **1.3**	**24** **1.2**	**24** **1.2**	**24** **1.2**	**24** **1.2**	**24** **1.2**	**21** **1.0**	**21** **1.0**	**25** **1.2**	**22** **1.1**
Tanzania	... ...	... ...	... ...	14 0.7	17 0.8	17 0.8	17 0.8	14 0.7	14 0.7	14 0.7	14 0.7	14 0.7	14 0.7	17 0.8
Togo	**...** **...**	**...** **...**	**...** **...**	**...** **...**	**20** **1.0**	**20** **1.0**	**20** **1.0**	**20** **1.0**	**20** **1.0**	**20** **1.0**	**20** **1.0**	**...** **...**	**...** **...**	**...** **...**
Tunisia	... ...	... ...	... ...	23 1.1	34 1.7	34 1.7	34 1.7	34 1.7	34 1.7	34 1.7	34 1.7	34 1.7	34 1.7	34 1.7
Zaire	**...** **...**	**...** **...**	**...** **...**	**21** **1.0**	**16** **0.8**	**17** **0.8**	**17** **0.8**	**17** **0.8**	**17** **0.8**	**17** **0.9**	**17** **0.8**	**17** **0.8**	**17** **0.8**	**17** **0.8**
Others	... ...	... ...	... ...	... ...	35 1.7	35 1.7	35 1.7	35 1.7	35 1.7	35 1.7	34 1.7	31 1.5	35 1.7	35 1.7
Total	**18** **0.8**	**39** **1.9**	**116** **5.7**	**787** **38.8**	**1,665** **82.9**	**1,893** **94.0**	**1,890** **93.8**	**2,457** **122.2**	**2,531** **125.8**	**2,524** **125.5**	**2,631** **130.8**	**2,789** **138.8**	**2,824** **140.4**	**2,874** **142.9**

MIDDLE EAST

Upper figures = 1,000 b/d
Lower figures = million t/y

	1940	1950	1960	1970	1980	1983	1984	1985	1986	1987	1988	1989	1990	1991
Abu Dhabi	... ...	... ...	... ...	... ...	14 0.7	135 6.7	185 9.2	185 9.2	185 9.2	185 9.2	180 9.0	180 9.0	180 9.0	193 9.6
Bahrain	33 1.6	150 7.5	187 9.3	205 10.2	250 12.5	250 12.5	250 12.5	250 12.5	250 12.5	250 12.5	250 12.5	243 12.1	243 12.1	243 12.1
Iran	333 16.6	502 25.0	495 24.7	645 32.1	921 45.9	530 26.4	530 26.4	530 26.4	530 26.4	530 26.4	530 26.4	530 26.4	530 26.4	720 35.9
Iraq	4 0.2	9 0.4	56 2.8	104 5.2	168 8.4	169 8.4	319 8.4	319 15.9	319 15.9	319 15.9	319 15.9	319 15.9	319 15.9	319 15.9
Israel	... ...	83 4.1	87 4.3	107 5.3	195 9.7	190 9.5	190 9.5	170 8.5	170 8.5	180 9.0	180 9.0	180 9.0	180 9.0	180 9.0
Jordan	... ...	... ...	... ...	7 0.4	21 1.0	100 5.0	100 5.0	100 5.0	100 5.0	100 5.0	100 5.0	100 5.0	100 5.0	100 5.0
Kuwait*	... ...	25 1.2	270 13.5	569 28.4	645 32.1	623 31.0	623 31.0	669 33.3	634 31.6	618 30.8	628 31.3	817 40.7	819 40.8	819 40.8
Lebanon	... ...	6 0.3	24 1.2	38 1.9	53 2.6	52 2.6	52 2.6	17 0.8	17 0.8	37 1.8	37 1.8	37 1.8	37 1.8	38 1.9
Qatar	... ...	... ...	1 ...	1 ...	11 0.5	12 0.6	63 3.1	56 2.8	56 2.8	62 3.1	62 3.1	62 3.1	62 3.1	62 3.1
Saudi Arabia*	... ...	140 7.0	189 9.4	377 18.8	487 24.3	705 35.1	860 42.8	840 41.8	1,115 55.5	1,125 56.0	1,375 68.5	1,375 68.5	1,484 73.9	1,863 92.8
Syria	... ...	... ...	... ...	59 2.9	223 11.1	229 11.4	229 11.4	228 11.4	229 11.4	229 11.4	229 11.4	244 12.2	244 12.2	237 11.8
Turkey	... ...	1 ...	7 0.3	149 7.4	356 17.7	467 23.3	472 23.5	460 22.9	460 22.9	460 22.9	676 33.7	725 36.1	725 36.1	729 36.3
Yemen	... ...	... ...	120 6.0	178 8.9	175 8.7	178 8.9	130 6.5	178 8.9	162 8.1	170 8.5	170 8.5	162 8.1	162 8.1	172 8.6
Others	... ...	... ...	... ...	... ...	... ...	46 2.3	48 2.4	50 2.5	48 2.4	58 2.9	87 4.3	87 4.3	87 4.3	76 3.8
Total	**370** **18.4**	**916** **45.5**	**1,436** **71.5**	**2,439** **121.4**	**3,519** **175.2**	**3,686** **183.7**	**3,901** **194.3**	**4,052** **201.9**	**4,275** **213.0**	**4,323** **215.4**	**4,823** **240.4**	**5,061** **252.2**	**5,172** **257.7**	**5,751** **286.6**
Total, excl. U.S.S.R., E. Europe	**6,817** **328.8**	**10,332** **523.9**	**21,015** **1,046.4**	**42,148** **2,098.4**	**65,974** **3,285.3**	**62,741** **3,124.3**	**60,522** **3,013.8**	**58,970** **2,986.2**	**57,400** **2,858.4**	**57,480** **2,863.4**	**58,296** **2,903.1**	**58,413** **2,908.8**	**58,706** **2,973.0**	**60,329** **3,004.1**

***Includes Neutral Zone.**

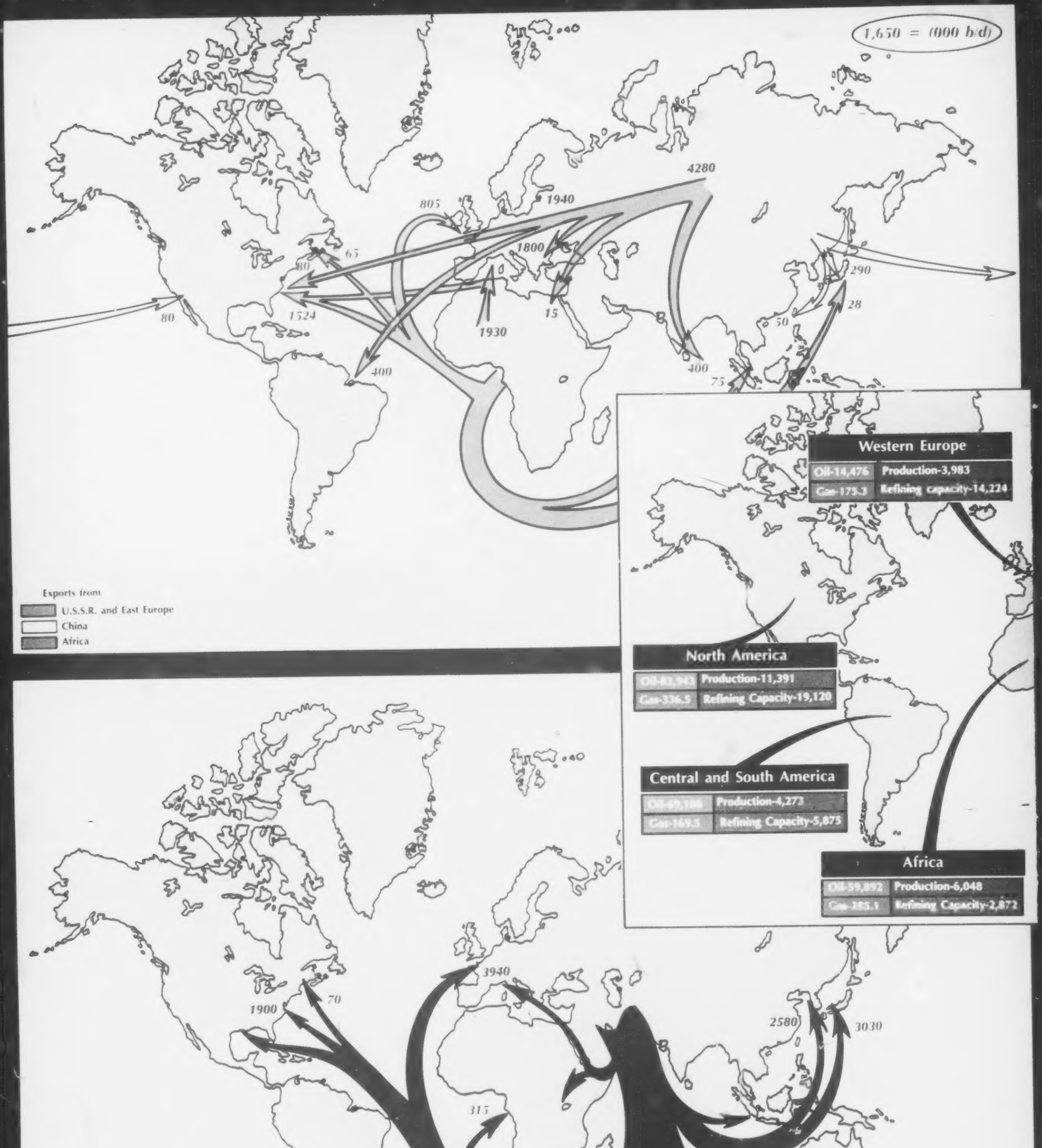
U.S.S.R.-EASTERN EUROPE

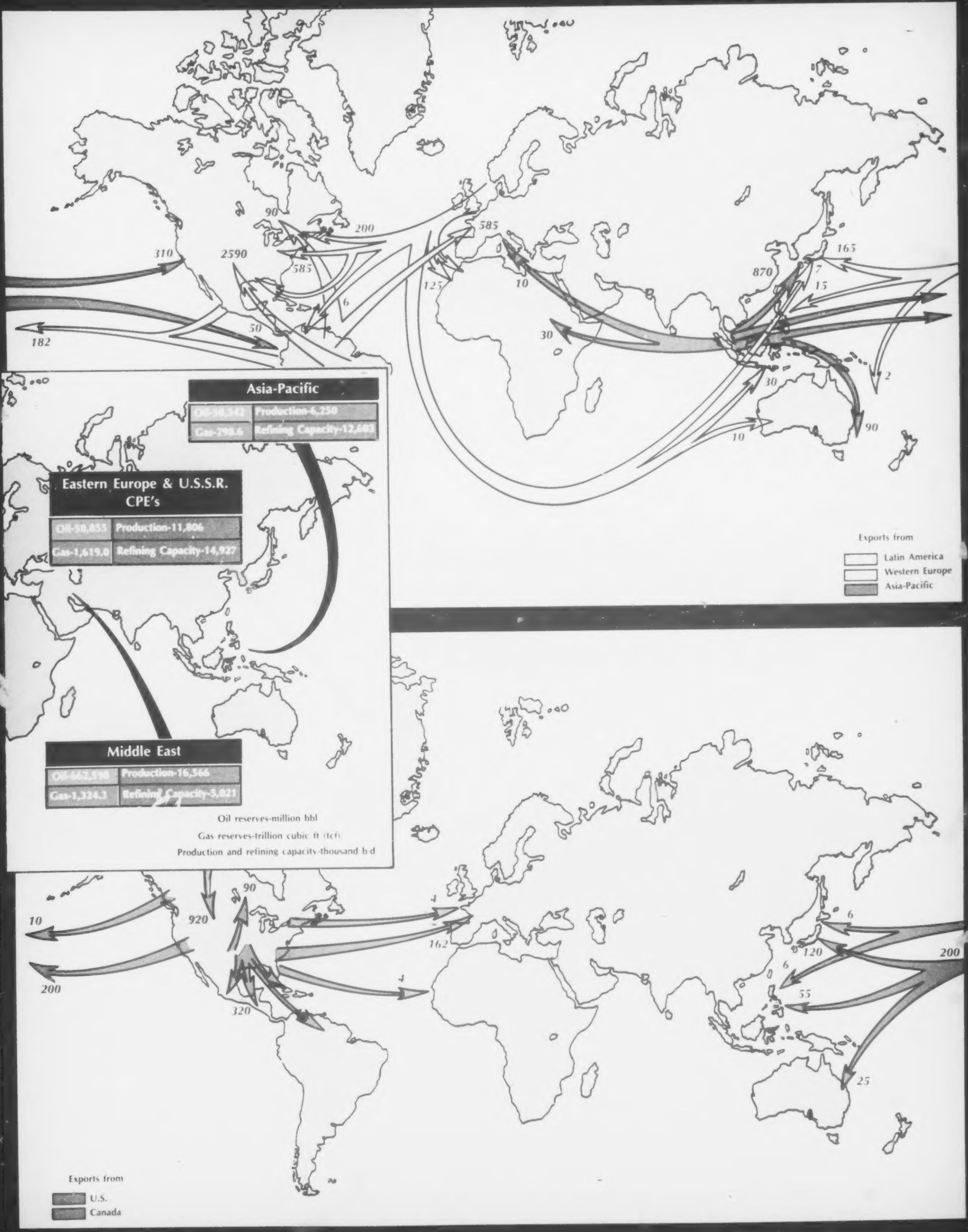
Upper figures = 1,000 b/d
Lower figures = million t/y

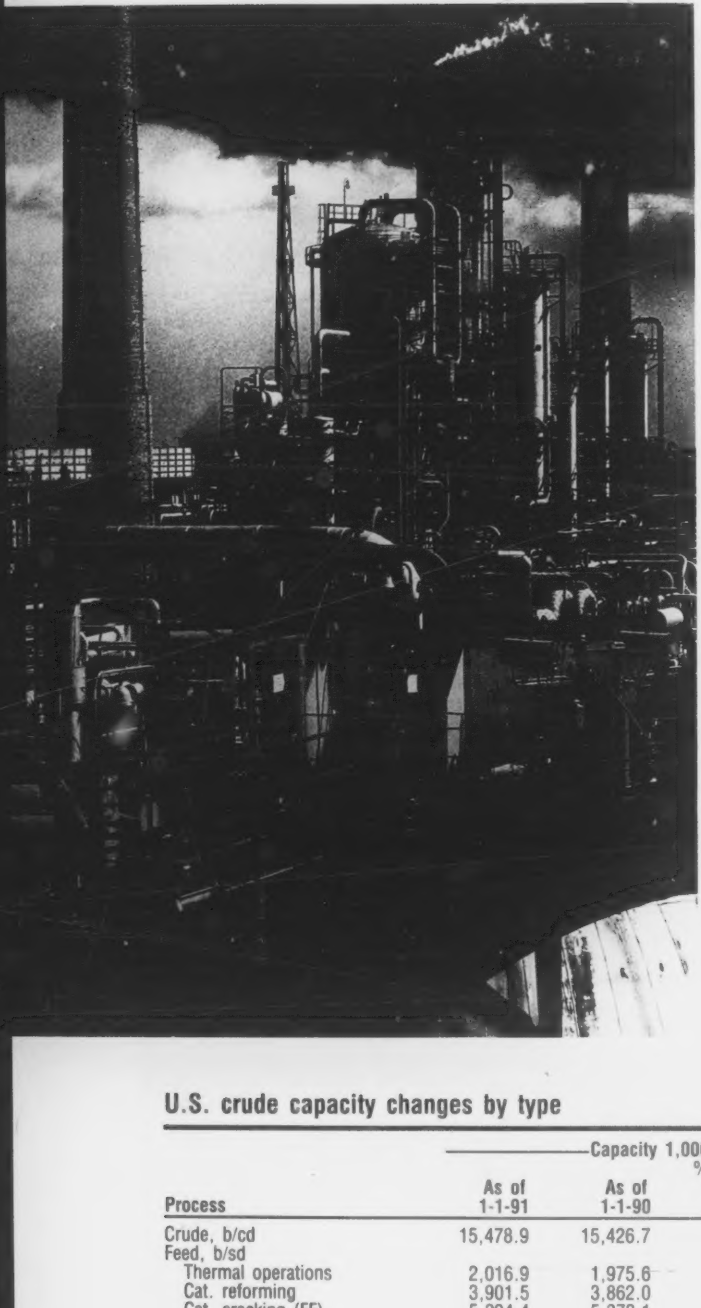
	1940	1950	1960	1970	1980	1983	1984	1985	1986	1987	1988	1989	1990	1991
Albania*	... ...	... ...	... ...	... ...	... ...	... ...	... ...	... ...	... ...	... ...	... ...	... ...	... ...	40 2.0
Bulgaria*	... ...	... ...	... ...	... ...	... ...	... ...	... ...	... ...	... ...	... ...	... ...	... ...	... ...	300 14.9
Czechoslovakia	... ...	16 0.8	46 2.3	220 11.0	455 22.7	455 22.7	455 22.7	455 22.7	455 22.7	455 22.7	455 22.7	455 22.7	455 22.7	455 22.7
Hungary	... ...	20 1.0	58 2.9	130 6.5	290 14.4	311 15.5	312 15.5	242 12.1	242 12.1	242 12.1	220 11.0	220 11.0	220 11.0	220 11.0
Poland	... ...	4 0.2	20 1.0	156 7.8	385 19.2	385 19.2	385 19.2	385 19.2	385 19.2	385 19.2	385 19.2	385 19.2	385 19.2	385 19.2
Romania	... ...	182 9.1	260 12.9	356 17.7	608 30.3	617 30.7	617 30.7	617 30.7	617 30.7	617 30.7	617 30.7	617 30.7	617 30.7	617 30.7
U.S.S.R.	... ...	900 44.8	2,800 139.4	5,640 280.9	10,950 545.3	11,750 585.2	12,000 597.6	12,200 607.6	12,260 610.5	12,260 610.5	12,260 610.5	12,300 612.5	12,300 612.5	12,300 612.5
Others	... ...	4 0.2	40 2.0	332 16.5	852 42.4	898 44.7	894 44.5	894 44.5	894 44.5	894 44.5	852 42.4	910 45.3	852 42.4	... ...
Total	... ...	**1,126** **56.1**	**3,224** **160.5**	**6,834** **340.4**	**13,540** **674.3**	**14,416** **718.0**	**14,663** **730.2**	**14,793** **736.8**	**14,853** **739.7**	**14,853** **739.7**	**14,789** **736.5**	**14,887** **741.4**	**14,829** **738.5**	**14,317** **713.0**
World Total	**6,817** **328.8**	**11,458** **580.0**	**24,239** **1,206.9**	**48,982** **2,438.8**	**79,514** **3,959.6**	**77,157** **3,842.3**	**75,185** **3,744.0**	**74,763** **3,723.0**	**72,253** **3,598.1**	**72,352** **3,603.1**	**73,085** **3,639.6**	**73,300** **3,650.2**	**74,535** **3,711.5**	**74,646** **3,717.1**

***Prior to 1991, included in others.**

World 1990: Oil production, refining capacity, oil movements, reserves


1,650 = (000 b/d)
4280
805
1940
1800
65
80
1524
15
1930
400
80
290
28
50
400
75
Exports from
U.S.S.R. and East Europe
China
Africa
Western Europe
Oil-14,476
Production-3,983
Gas-175.3
Refining capacity-14,224
North America
Oil-83,943
Production-11,391
Gas-336.5
Refining Capacity-19,120
Central and South America
Oil-69,188
Production-4,273
Gas-169.5
Refining Capacity-5,875
Africa
Oil-59,892
Production-6,048
Gas-285.1
Refining Capacity-2,872
3940
1900
70
2580
3030
315
410
195
Exports from Middle East


310
2590
90
200
585
585
125
6
50
182
10
30
870
165
7
15
2
30
90
10
Exports from
Latin America
Western Europe
Asia-Pacific
Asia-Pacific
Oil-50,242
Production-6,250
Gas-298.6
Refining Capacity-12,603
Eastern Europe & U.S.S.R. CPE's
Oil-50,855
Production-11,806
Gas-1,619.0
Refining Capacity-14,927
Middle East
Oil-662,590
Production-16,566
Gas-1,324.3
Refining Capacity-5,021
Oil reserves-million bbl
Gas reserves-trillion cubic ft (tcf)
Production and refining capacity-thousand b/d
90
4
920
10
162
200
4
320
6
120
200
6
55
25
Exports from
U.S.
Canada



SCHWEDT REFINERY in eastern Germany is among former eastern block plants joining Europe's refining network. The massive changes accompanying the introduction of a market economy in eastern Europe will include a dramatic overhaul of the formerly Communist downstream industry to accommodate western level products needs and environmental concerns. (Photo courtesy PCK AG Schwedt.)

High margins, healthy profits seen for refiners

REFINERS UNDERWENT A WATERSHED YEAR IN 1990.

Mounting environmental concerns forced refiners worldwide to earmark billions of dollars to reduce the environmental effects of their operations and to revamp plants to accommodate a changing product slate to meet air quality concerns.

U.S. refiners mounted a widespread campaign to introduce reduced emission gasolines and other products touted as being more environmentally benign. The effort probably helped them avoid a more draconian Clean Air Act, although there remain pitfalls in the final legislation President Bush signed in November 1990.

In Europe, the quickly expanding demand for unleaded gasoline is forcing refiners to accelerate spending for upgrading refineries to produce more of the product.

European refiners are leading the frenzied rush into downstream joint ventures in eastern Europe, where a promised renaissance of the formerly Communist bloc's dilapidated refining/marketing sector will provide major business opportunities in the 1990s. Even the Soviet Union's bedraggled downstream sector offers the promise of a huge modernization program, assuming chaos doesn't overtake that troubled nation.

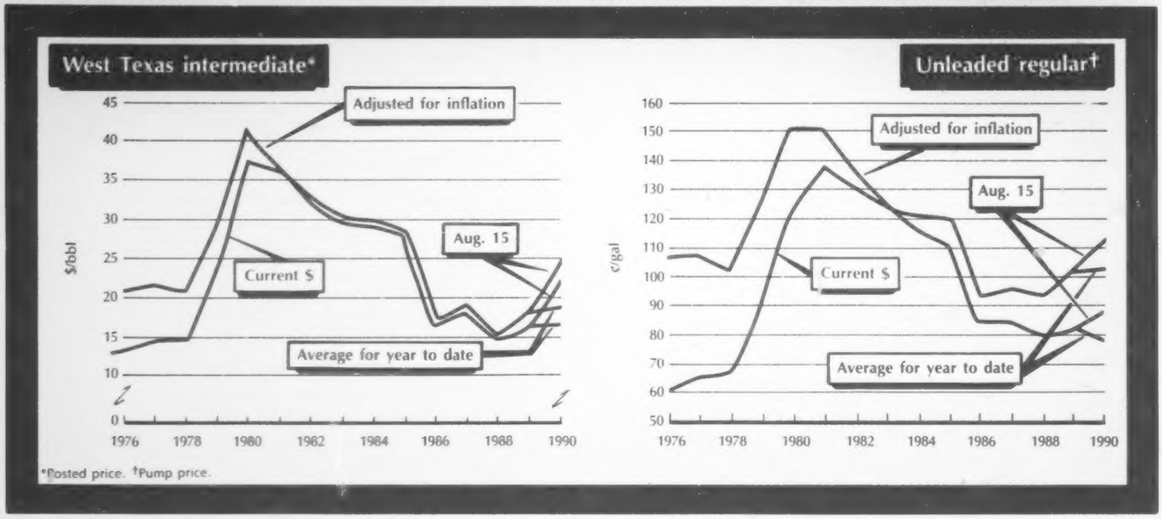
Table 1

U.S. crude capacity changes by type

	Capacity 1,000 b/d				Construction, 1,000 b/d		
Process	As of 1-1-91	As of 1-1-90	% change from 1-1-90	Vol. chg. from 1-1-90	1991 Completion	Est. % change by 1-1-92	1992 Completions*
Crude, b/cd	15,478.9	15,426.7	0.3	52.2	94.5	0.61	97.0
Feed, b/sd							
Thermal operations	2,016.9	1,975.6	2.0	41.3	1.6	0.1	10.0
Cat. reforming	3,901.5	3,862.0	1.0	39.5	89.5	2.3	94.0
Cat. cracking (FF)	5,294.4	5,372.1	−1.5	−77.7	51.2	1.0	0.0
Cat. Hydrocracking	1,260.8	1,209.5	4.1	51.3	25.5	2.0	37.0
Hydrorefining	2,446.9	2,410.0	1.5	36.9	12.0	0.5	6.5
Hydrotreating	7,270.1	7,137.8	1.8	132.3	59.9	0.8	78.0
Products, b/sd							
Alkylation	1,072.4	1,031.3	3.8	41.1	11.7	1.1	12.0
Aromatics/Isom.	836.3	784.9	6.2	51.4	19.7	2.4	12.5
Lubes	224.7	236.9	−5.4	−12.2	3.8	1.7	5.9
Coke, 1,000 tons/day	77.5	74.4	3.9	3.1	0.0	0.0	0.8
Asphalt	748.7	754.5	−0.8	−5.8	13.7	1.8	0.0

*Based on reported projects known to date.

How U.S. crude and gasoline prices have varied



*Posted price. †Pump price.

Sweeping change in Latin America, paced by privatization and economic reform among South America's state oil companies, offers a no less exciting prospect for investment in refining operations there. Economic reform has included moves to end subsidized fuels prices in the region, which has hamstrung the state companies in the past.

Because the fastest growing demand for petroleum products during the 1990s is expected to occur in the Asia-Pacific region, there is a strong effort to boost downstream capacity to better meet domestic demand and increase products exports as well.

Members of the Organization of Petroleum Exporting Countries continued their efforts to acquire downstream interests in other nations as well as increase domestic capacity. But that push was dealt a severe blow—as were refiners' margins and profits—by Iraq's blitzkrieg invasion and takeover of Kuwait and the subsequent breakout of war in the Persian Gulf stemming from that action.

Refiners in 1991 will be especially hard pressed to sustain healthy margins if the Persian Gulf conflict manages to result in higher crude oil prices. Oil companies were blistered by political and consumer/environmentalist lobbies after a rapid runup in crude and products prices during the Middle East crisis led to charges of price-gouging. In fact, refiner/marketers efforts to restrain product price increases while crude prices remained high caused refining profits to plummet in second half 1990.

Refineries worldwide were expected to continue operating all out in 1991, mainly because of the loss of sophisticated Kuwaiti refining capacity dismantled by the invading Iraqis. Refiners also took heart when the prospect suddenly loomed early in 1991 that crude oil prices might again

Table 2

U.S. capacity changes by region*

Process	PADD I*	PADD II	PADD III	PADD IV	PADD V	Total
No. refineries	20	41	66	18	49	194
Crude, b/cd	1,523,630	3,393,475	6,874,811	548,900	3,138,133	15,478,949
% of U.S. capacity (b/cd basis)	9.8	21.9	44.4	3.5	20.3	
Crude, b/sd	1,618,947	3,554,867	7,243,686	578,400	3,308,054	16,303,954
Cat. cracking (FF), b/sd	602,500	1,290,500	2,405,600	201,300	794,500	5,294,400
% U.S. capacity	11.4	24.4	45.4	3.8	15.0	
Cat. reforming, b/sd	344,670	933,300	1,795,900	128,650	699,000	3,901,520
% U.S. capacity	8.8	23.9	46.0	3.3	17.9	
Hydrocracking, b/sd	74,500	161,890	522,500	9,900	492,000	1,260,790
% U.S. capacity	5.9	12.8	41.4	0.8	39.0	
Hydrorefining & hydrotreating, b/sd†	521,400	944,500	2,898,250	150,750	1,099,900	5,614,800
% U.S. capacity	9.3	16.8	51.6	2.7	19.6	
Alkylation, b/sd	85,500	272,000	526,100	34,100	154,700	1,072,400
% U.S. capacity	8.0	25.4	49.1	3.2	14.4	
Coking, b/sd	30,040	114,382	241,726	7,342	183,831	577,320
% U.S. capacity	5.2	19.8	41.9	1.3	31.8	

*PADD I includes East Coast and Southeast, PADD II includes North Central states, PADD III includes Gulf Coast and southern Midcontinent, PADD IV includes Rocky Mountain states, and PADD V includes West Coast, Hawaii, and Alaska. †Excludes pretreating catalytic reformer feed, naphtha desulfurization, and naphtha, olefin, and aromatics saturation.

Table 3

U.S. upgrading capacity changes

	Capacity 1-1-91	Capacity 1-1-90	% Change
	1,000 b/d		
Hydrorefining			
Resid & heavy gas oil	779.8	852.6	−9.3
FCC & cycle stock pretreatment	1,170.5	1,061.5	9.3
Mid distillate	437.3	421.4	3.6
Other	59.3	74.5	−25.6
Hydrotreating			
Cat. reformer feed & naphtha desulfurization	3,951.8	3,959.0	−0.2
Straight run distillate	1,546.4	1,369.4	11.4
Other distillate & material	1,400.3	1,429.8	−2.1
Lube oil polishing	221.2	223.7	−1.1
Naphtha olefin & aromatics saturation	150.4	177.5	−18.0

collapse during the year. The harbinger of that development came with the market response to the outbreak of hostilities in the Persian Gulf. After a rapid buildup in Saudi and other OPEC productive capacity, coupled with reduced demand owing to higher oil prices, the market essentially was in balance ahead of war in the Middle East. Only the fear of a further loss of production capability kept oil prices higher than normal. When it quickly became apparent that Iraq's threat to the rest of the region's oil productive capacity was greatly diminished following a massive U.S. led allied offensive against Iraq's war machine, and the International Energy Agency and U.S. government took steps to tap strategic oil reserves, oil prices dropped like a rock. There emerged a surprising new consensus in oil markets ahead of the seasonally weak second quarter: even with a war under way in the Middle East, a crude oil price collapse was a strong possibility because of a surfeit of crude on the market amid softer demand.

That paradox only underscores the range of pitfalls and opportunities facing refiners during the 1990s.

U.S. refining changes

U.S. crude distillation capacity rose slightly in 1990, although conversion and treating capacity posted sizable gains. That trend tracked buoyant demand for gasoline, diesel, and other high quality products in most of 1990.

Absent further market dislocations such as occurred in the wake of the Middle East crisis, industry capacity should remain closely balanced with demand. That will mean high operating utilization rates and healthy margins during the early 1990s.

U.S. refinery utilization rose during the latter half of the 1980s after a huge shakeout had stripped much of the U.S. capacity during the early 1980s. With only slight increases in capacity and steadily rising demand during the last half of the 1980s, U.S. refinery utilization climbed to 80-90% by 1990.

Capacities of the primary downstream refining processes that yield gasoline and diesel logged respectable gains in 1990, while processes that treat feeds to the primary processes jumped sharply because of increased feed demand for conversion and light fuels production processes.

The gains in downstream capacity also reflect industry's efforts to meet increasingly stringent air quality rules that require higher oxygen content gasolines in winter in some areas of the U.S. and that mandate reduced volatility of summertime gasoline across the U.S.

Still tougher rules governing air emissions of motor fuels by specifying their formulas are on the horizon. Even with

Table 4

U.S. capacity by refiner size

	Companies with more than 200,000 b/cd crude capacity 1-1-91	Companies with more than 200,000 b/cd crude capacity 1-1-90	Companies with less than 200,000 b/cd crude capacity 1-1-91	Companies with less than 200,000 b/cd crude capacity 1-1-90
No. companies	20	19	92	87
No. refineries	88	89	106	102
Crude capacity, b/cd	11,692,275	11,947,325	3,786,674	3,611,598
Crude capacity, b/sd	12,295,520	12,596,372	4,008,434	3,815,506
% U.S. capacity (b/cd basis)	75.5	76.8	24.5	23.2
Cat. cracking (FF), b/sd	4,299,900	4,333,700	1,144,500	1,070,400
% on crude	35.0	34.4	28.6	28.0
Cat. reforming, b/sd	3,083,000	3,106,000	818,520	815,970
% on crude	25.1	24.7	20.4	21.4
Hydrocracking, b/sd	1,134,600	1,089,600	126,190	153,800
% on crude	9.2	8.7	3.1	4.0
Hydrorefining & hydrotreating, b/sd*	4,693,450	4,693,450	817,650	787,400
% on crude	39.0	37.3	20.4	20.6
Alkylation, b/sd	835,700	817,600	240,000	213,700
% on crude	7.0	6.5	6.0	5.6
Coking, b/sd†	1,376,200	1,321,900	239,100	216,400
% on crude	11.2	10.5	6.0	5.7

* Excludes pretreating cat. reformer feed, naphtha, desulfurization and naphtha, olefin, or aromatics saturation. †Includes fluid and delayed coking.

Table 5

Breakout of large U.S. refiners' capacities

Company	No. Refineries	—Crude Capacity— b/cd	b/sd	Cat Cracking Fresh Feed b/sd	Cat Reforming b/sd	Hydro-cracking b/sd	Hydrorefining Hydrotreating b/sd*	Alkylation b/sd	Coking b/sd†
Chevron U.S.A.	12	1,575,700	1,650,000	421,000	334,600	223,500	700,100	80,400	178,600
Exxon Co.	5	1,147,000	1,197,000	574,000	283,000	80,900	679,100	93,100	153,200
Shell Oil Co.	7	1,096,200	1,142,000	319,500	298,000	161,500	507,300	77,000	95,000
Amoco Oil Co.	7	1,002,000	1,048,500	430,000	282,000	120,000	370,600	101,800	84,800
Mobil Oil Corp.	5	838,000	902,000	357,000	255,500	71,700	421,550	80,500	169,500
BP Oil Co.	5	744,800	784,000	259,500	199,500	80,000	147,000	64,300	55,000
ARCO	5	684,500	726,500	172,000	214,000	74,000	298,000	28,000	14,600
Marathon Petroleum Co.	5	636,000	661,000	217,500	162,000	24,000	151,000	59,000	22,000
Star Enterprise	3	615,000	663,000	264,000	142,000	84,000	256,900	42,200	46,000
Sun Refining & Marketing Co.	4	505,000	538,000	206,000	159,200	58,200	117,900	26,800	0
Conoco Inc.	5	406,500	424,000	133,500	88,700	0	207,300	25,500	80,500
Texaco Refining & Marketing Inc.	4	351,000	365,000	109,500	103,500	40,300	148,000	28,800	123,200
Ashland Petroleum Co.	3	346,500	357,220	148,000	95,500	0	184,000	24,500	0
Koch Refining Co.	2	343,500	360,000	95,000	80,500	0	117,500	16,900	70,000
Citgo Petroleum Corp.	1	320,000	330,000	0	106,000	45,000	68,000	23,000	88,000
Phillips 66 Co.	3	305,000	331,000	155,400	68,000	0	216,600	31,100	0
Hill Petroleum Co.	4	275,500	291,700	139,000	48,500	0	59,000	10,000	0
Coastal Refining and Marketing Inc.	6	274,075	288,500	102,000	76,500	10,000	84,800	12,800	17,500
Unocal Corp.	2	226,000	236,100	47,000	86,000	61,500	62,500	10,000	46,900
Total	**88**	**11,692,275**	**12,295,520**	**4,299,900**	**3,083,000**	**1,134,690**	**4,797,150**	**835,700**	**1,376,200**

*Excludes pretreating cat. reformer feed, naphtha desulfurization, and naphtha, olefin, or aromatics saturation. †Includes fluid and delayed coking.

increases in crude and downstream processing capacity, the more stringent rules might squeeze U.S. refiners' ability to meet demand.

Those concerns notwithstanding, the tighter rules' crunch on capacity will tend to keep refiners' margins healthy through much of the 1990s—assuming crude costs remain near an equilibrium level.

Capacity changes

U.S. crude charging capacity inched up only 52,200 b/cd to 15,478,900 b/cd as of Jan. 1, 1991, compared with its prior year level.

Fluid catalytic cracking capacity slipped 1.5% in 1990 to about 5.294 million b/sd. That trend is likely to reverse in 1991 with the expected addition of 51,200 b/sd in FCC capacity.

Catalytic hydrocracking capacity increased 4.1% to about 1.26 million b/sd as of Jan. 1, 1991, while alkylation capacity rose 3.8% to 1.072 million b/d, and aromatics/isomerization capacity shot up 6.2% to about 836,000 b/d.

Feed treating process capacities jumped accordingly. Overall U.S. hydrotreating capacity climbed 1.8% to about 7.27 million b/sd in 1990. As of Jan. 1, 1991, FCC and cycle stock capacity posted a 9.3% rise to about 1.17 million b/sd from the previous year's level.

During the same period, catalytic naphtha reformer feed treatment and naphtha desulfurization capacity slipped 0.2% to about 3.95 million b/sd.

The biggest increase among U.S. refining capacity types in 1990 occurred in straight run distillate hydrotreating, up 11.4% to about 1.55 million b/d. That is partly due to new construction and partly reflects a shift or a redefinition of the types of materials being hydrotreated. That can be seen in the decline in other distillate and material hydrotreating capacity, which fell 2.1% to about 1.41 million b/sd.

The trend toward converting heavier feedstocks into light products was slowed with the reversal in resid/heavy gas oil hydrorefining capacity, which fell 9.3% to 779,800 b/sd as of Jan. 1, 1991, following a 2% gain in 1989.

There is not likely to be much in the way of grassroots refinery construction in the U.S. during the 1990s. Although the economics are better than in the early 1980s with operating utilization rates expected to remain high and crude costs—absent more turmoil in the Middle East—expected to remain relatively low, any incremental distillation capacity probably will be added only through debottlenecking and efficiency improvements.

Margins in the 1990s, while expected to remain healthy, still are not likely to justify the economics of a new grassroots refinery of any significant scale or sophistication in the U.S.

The same environmental impetus that will keep refinery margins strong in the 1990s through new air quality rules also contributes to a regulatory thicket that makes it all but impossible to obtain construction permits for a new refinery

Table 6

Alkylation growth

	B/sd 1985	1986	1987	1988	1989	1990	1991
Sulfuric acid	481,875	477,400	490,600	485,700	498,200	499,500	516,500
Hydrofluoric acid	430,950	456,150	481,350	498,400	515,500	528,800	555,900
Total	**912,825**	**933,550**	**971,950**	**984,100**	**1,013,700**	**1,028,300**	**1,072,400**

Table 7

U.S. MTBE capacity

Company	Location	(B/d)
Amoco Oil Co.	Whiting, Indiana	4,000
Amoco Oil Co.	Yorktown, Virginia	800
Ashland Petroleum Co.	Catlettsburg, Kentucky	3,200
Atlantic Richfield Co.	Carson, California	2,400
Champlin Refining & Chemicals Inc.	Corpus Christi, Texas	1,700
Chevron U.S.A. Inc.	El Segundo, California	2,300
Citgo Petroleum Corp.	Lake Charles, Louisiana	2,100
Coastal Refining & Marketing Inc.	Corpus Christi, Texas	12,000
Crown Central Petroleum Corp.	Houston, Texas	5,000
Hill Petroleum Co.	Houston, Texas	1,300
Lyondell Petrochemical Co.	Houston, Texas	2,100
Marathon Petroleum Co.	Detroit, Michigan	1,100
Mobil Oil Corp.	Beaumont, Texas	2,200
Phillips 66 Co.	Sweeny, Texas	3,000
Sun Refining & Marketing Co.	Marcus Hooks, Pennsylvania	2,600
Valero Refining Co.	Corpus Christi, Texas	2,200
TOTAL		**48,000**

in the U.S.

Although products demand and refinery margins plunged after the onset of the Middle East crisis in second half 1990, an end to the crisis is likely to keep capacity in close balance with demand, which should return to its normal growth patterns after the war and its market aftermath have run their course.

World refining trends

Worldwide refining capacity as of Jan. 1, 1991, was 588,000 b/d higher than the previous year's total.

Two Persian Gulf refineries accounted for most of that increase. Saudi Arabia started up the 332,500 b/d Petromin Petrola Rabigh Refining Co. plant at Rabigh in 1990. Iran brought its 190,000 b/d refinery at Abadan—shut down for repairs of damage from attacks during the Iran-Iraq war—back on stream.

In Europe, the idled 78,000 b/d refinery Holborn Europa Raffinerie BmbH operates at Harburg, Germany, also restarted.

Environmental concerns will spur big outlays for process changes and tighter safeguards outside the U.S. in the 1990s.

Royal Dutch/Shell Group plans big investments in refining capacity in France and Switzerland to accommodate product and environmental needs in the 1990s.

Shell France tentatively plans to spend $200 million on its 128,000 b/d Berre refinery in southern France. About a fourth of that expenditure will go for environmental protection.

Shell Raffinerie Cressier, after completing a $4.4 million program to meet local air quality rules in Switzerland, will spend another $40 million to upgrade environmental protection systems by 2000.

Another key trend outside the U.S. is the push toward privatization and market economies. Hungary was among the first of the former Soviet Satellites to do so, ending its state monopoly on oil imports and allowing market forces to set gasoline prices effective Jan. 1, 1991.

Europe

The big refining story in Europe at the close of the last decade was the rapid market penetration of unleaded gasoline.

Unleaded's market share in Europe climbed to more than 30% by midyear 1990 from 27% at yearend 1989.

At the start of 1990, Europremium 95 RON/85 RON was available at more than 81,400 service stations, superpremium 98 RON at 25,580 sations, and regular 91/92 RON at more than 21,100 stations.

Unleaded's growth has proven to have a sharp regional bias in Europe. In Germany, where the environmental lobby is the strongest in Europe, unleaded commands a market share of about 65%. In Spain and Portugal, however, the unleaded market share remains less than 1%. There has been even less progress in the newly emerging democracies of eastern Europe, although that will change soon.

The dramatic growth in unleaded gasoline demand in Europe stems from the introduction of tax incentives in countries where there is ample supply of the fuel.

In Denmark, where there is the equivalent of 10¢/1. tax differential between leaded and unleaded, more than 51% of gasoline sales are unleaded.

Spain, without incentives, has the lowest level of unleaded sales in Europe.

However, Greece, with a strong differential of 7¢/1., has an unleaded market share of less than 1%. That's because only 6.4% of that country's service stations offers unleaded gasoline.

Even with unleaded's market share expected to continue expanding in the 1990s, spending to accommodate that growth won't account for a major role in European refiners' investments in the 1990s.

An Arthur D. Little study forecasts European refiners will have to spend $6 billion to upgrade capacity by 2000.

By far the biggest component of that sum will entail reducing the sulfur content of diesel fuel and positioning refiners to meet a lighter barrel in the 1990s.

It is not likely that Europe's refiners will have to go as far as their U.S. counterparts to reformulate fuels to meet air quality needs. The gasoline pool in Europe has a much lower level of olefins than does that in the U.S. In addition, Europe does not have the severe smog problems seen in the U.S., and the trend toward managing evaporative emissions is through big carbon canisters on vehicles.

Another key refining trend in Europe during the 1990s will be the total rehabilitation of the refining/marketing sector of the former Soviet satellites.

Companies in former West Germany are grappling with expanding operations in the former East Germany while at the same time trying to provide a western style level of service.

The post-reunification eastern Germany will have about 3,000 retail outlets, compared with 1,300 previously, companies in the western part of the country estimate.

Table 8

Unleaded gasoline tax incentives*

		Tax incentive			
	Grade (RON)	Local currency (LC)	LC/ liter	Exhange rate	U.S.¢/ liter
Austria	92	schilling	0.64	11.807	5.78
Austria	95	schilling	0.53	11.807	4.79
Belgium	98	franc	1.65	35.02	4.71
Belgium	95	franc	1.81	35.02	5.17
Belgium	92	franc	1.88	35.02	5.37
Denmark	All	krone	0.69	6.47	10.66
Finland	92	mark	0.325	4.04	8.04
France	All	franc	0.41	5.69	7.21
Greece	95	drachma	11	164.3	6.70
Iceland	92	known	3.88	61.41	6.32
Ireland	All	pence	2.2	0.632	3.48
Italy	95	lire	71	1,244.12	5.71
Netherlands	All	cents	9	1.89	4.76
Norway	All	oere	51	6.47	7.88
Portugal	95	escudos	6.2	197.63	4.20
Spain	95	pesetas	0	108.28	0
Sweden	95	krone	0.24	6.14	3.91
Switzerland	95	cents	8.68	1.49	5.83
West Germany	All	pfennig	9.1	1.68	5.42
U.K.	98	pence	3.07	0.589	5.21
U.K.	95	pence	2.79	0.589	4.74

*Superpremium unleaded (98 RON) is available in many countries. Tax incentives are the same as for Europremium grade.

Source: Concawe

Table 9

Market shares of unleaded gasoline

	Regular 92 RON	Euro-premium 95 RON	Super-premium 98 RON
Austria	30	15	—
Belgium	0.5	19	3
Denmark	8	30	13
Finland	—	50	—
France	—	15	9
Greece	—	0.5	—
Ireland	—	12	0.6
Italy	—	3	—
Netherlands	—	34	8.5
Norway	—	28	1.5
Portugal	—	0.3	—
Spain	—	<1	—
Sweden	—	46	0.2
Switzerland	—	45	—
West Germany	34	23	8
U.K.	—	27	2

Source: Concawe

prevent and remove deposits.

Doscher expects reformulated gasolines will be required for all cars in nonattainment areas but relatively minor changes will be needed for gasoline sold in standards that meet federal air quality standards. About one fourth of U.S. gasoline is used in nonattainment areas.

Doscher estimates reformulated gasoline will cost 7-12¢/gal more to produce than conventional gasoline.

Sulfur probably will be limited to 0.05 wt % in diesel fuel by 1993.

Arthur D. Little sees reformulation as more pervasive. The analyst expects most or all U.S. gasoline will have to be reformulated by 2000, calling for a $22 billion investment by U.S. refiners.

Crisis effects

The Persian Gulf crisis turned what had been for refiners an excellent second half 1990 into a nightmare.

Oil markets responded to Iraq's seizure of Kuwait on Aug. 2, 1990, by sending spot and futures prices to their highest levels in almost 5 years.

West Texas intermediate for next month delivery on the New York Mercantile Exchange soared to $28.05/bbl on closing Aug. 6, up more than $8/bbl on the week. Brent blend spot 15 day deliveries closed Aug. 7 almost $7 higher on the week at $25.90/bbl.

Products prices on spot and futures markets followed suit. Nymex unleaded gasoline closed Aug. 7 almost 17¢ higher at 82.39¢/gal, and heating oil futures rose about 10¢ to 75.14¢/gal in a comparison of the same period.

Prices skyrocketed at the pump as well. The average price of unleaded self-serve regular gasoline jumped more than 16¢ in the week following the invasion, reaching $1.237/gal, the highest in 5 years.

Refiner/marketers, especially in the U.S., were hit by claims of price gouging and profiteering related to the price hikes. Subcommittees in Congress launched investigations into the charges, as did the U.S. Justice Department.

President Bush and the Department of Energy called on U.S. consumers to begin conservation measures. Bush also called on U.S. oil companies to show restraint in gasoline pricing.

Price freezes

Oil companies responded to the President's request, with ARCO the first.

It froze gasoline, diesel, and jet fuel prices Aug. 8. ARCO warned at the time that if its prices were significantly out of line with world market prices during that time it would have raised them again, especially if the result were runouts at its service stations.

Quickly following ARCO's lead were Amoco Oil Co., Phillips Petroleum Co., Chevron Corp., BP America, Unocal Corp., and Getty Petroleum Corp.

However, ARCO's warning came to pass. The company's price freeze lasted 2 weeks before a flurry of service station runouts forced ARCO to abandon the freeze. ARCO then hiked gasoline prices by an average 2.5¢/gal in response to a 19% jump in sales volumes and gasoline runouts at more than 160 stations every day. During the price freeze, ARCO's regular unleaded sold for as much as 13¢/gal below the general market.

With that kind of panic buying pressuring the market, other refiner/marketers followed suit, and the average retail price of gasoline shot up about 8-10¢/gal as the freezes came off after only 2 weeks. That sparked a fresh outcry by U.S. oil industry critics.

Industry's image took a hammering in Europe as well. U.K. companies, after keeping a lid on retail prices for several weeks, boosted prices for premium unleaded 4 pence/imp. gal to 217 pence/imp. gal.

That elicited calls from Conservative as well as Labour party politicians for an investigation by Britain's Office of Fair Trading and from Prime Minister Thatcher for price restraint.

In addition to concerns over crude supplies arising from the international embargo against Iraq and Kuwait, markets remained skittish about the flexibility of the world refining system in the crisis. Supply problems had been expected for the loss of about 600,000 b/d of sophisticated refining capacity in Kuwait.

Table 10

Venezuela's refining interests

DOMESTIC REFINERIES

	Atmospheric distillation	Capacities Effective conversion (1,000 b/d)	Crude processed
Amuay	571	340	428
Cardon	286	260	235
Puerto La Cruz	195	100	126
El Palito	105	105	102
El Toreno/San Roque	10	10	10
Total	**1,167**	**815**	**901**

REFINERIES OUTSIDE VENEZUELA

Location/ company name	Pdvsa share (Percent)	Installed capacity	Venezuelan crude processed (1,000 b/d)
Belgium			
Antwerp/Nynas	50	15	10
Germany			
Schloven/Ruhr Oel	50	110	97
Horstadt/Ruhr Oel	50	100	97
Neustadt/Ruhr Oel	12.5	144	38
Karlsruhe/Ruhr Oel	16	142	38
Netherlands Antilles			
Curacao/Refineria	(Leased)	310	179
Sweden			
Nynashamn/AB Nynas Petroleum	50	25	12
Gothenberg/AB Nynas Petroleum	50	12	5
U.S.			
Lake Charles/Citgo	100	320	136
Corpus Christi/Champlin	100	165	131
Chicago/Uno-Ven	50	153	56
Total		**1,496**	**664**

Table 11

India's refining capacity, location

	Capacities			
Company, location	Distillation	Delayed coker	Visbreaker	FCC
	1,000 b/d			
Indian Oil corp Ltd.				
Digboi	10	0.8	—	—
Gauhati	17	6.0	—	—
Barauni	66	22.0	—	—
Haldia	50	—	9.2	—
Koyali	146	—	20.0	20.0
Mathura	120	—	20.0	20.0
Hindustan Petroleum Corp. Ltd.				
Bombay	110	—	—	8.0
Visakhapatnam	90	—	—	20.0
Bharat Petroleum Corp. Ltd.				
Bombay	120	—	—	24.0
Madras Refineries Ltd.				
Madras	112	7.4	1.2	—
Cochin Refinereis Ltd.				
Ambalamugal	90	—	24.6	20.0
Bongaigaon Refineries & Petrochemicals Ltd.				
Bongaigaon	27	10.0	—	—
Total	**958**	**46.2**	**75.0**	**112.0**

Source: East-West Center

The political uproar over alleged price gouging notwithstanding, the price restraint that refiner/marketers showed during the crisis slashed margins, and thus downstream profits plunged in fourth quarter 1990.

In fact, gasoline remained a bargain during a period when crude oil prices soared to record levels in the weeks and months following the onset of the crisis. Even after gasoline prices jumped about 18¢/gal in the 2 weeks following the crisis, the inflation adjusted price of gasoline was only about 8¢ higher than its post-price collapse low in 1988. Adjusted for inflation, the price of leaded regular gasoline at the time was lower than anytime since 1918 except for 1972-73 and 1986-89. By contrast, the posted price of about $25/bbl for WTI adjusted for inflation would be $21.66/bbl, or about half the inflation adjusted peak in 1980 and more than double the inflation adjusted average price during 1950-1973.

That would suggest that the competitive nature of the U.S. gasoline market—when free of regulatory intervention—has kept U.S. gasoline consumers mostly shielded from spikes in the price of crude oil.

Still, refiner/marketers resorted to the same efforts at self-imposed price restraint when the Persian Gulf crisis turned into war Jan. 16, 1991. Most U.S. refiner/marketers announced retail and wholesale price freezes shortly after news came of an air attack upon military targets in Iraq and Kuwait in response to Iraq's disregard of a U.N. deadline of Jan. 15 for withdrawing from Kuwait. Then, the market responded to the astonishing speed with which uncertainty over the security of Persian Gulf oil supplies was resolved. After jumping about $8 during the first few hours of the onset of hostilities, oil prices plunged. The awareness that Iraq's ability to further disrupt the region's oil supplies had been all but eliminated by the allied air attacks within the first few days of the conflict, the surprising effectiveness of the Saudis and others in OPEC to boost production to compensate for the loss of Iraqi/Kuwaiti supplies, and the decisions by the International Energy Agency and U.S. DOE to draw down strategic reserves calmed a nervous market. Within a few weeks, oil prices again were at precrisis levels.

Unfortunately, refiner/marketers' efforts to show price restraint by implementing products price freezes blew up in their faces. Freezing products prices when crude prices were falling was seen as greed instead of just inept public relations.

With a surplus of crude supplies and refining capacity tight worldwide, refiner/marketers approached second quarter 1991 with the realization that no one had predicted: That oil prices could collapse even with the destruction of crude productive capacity in two major OPEC exporting nations as a result of a Persian Gulf war.

That points to a likely healthy outlook for world refining in the 1990s. Crude prices are likely to remain generally low—albeit with brief flurries of volatility.

Refining capacity is likely to remain tight in response to rebounding demand—notably in the Asia Pacific region—and reconfigured process schemes caused by accommodating new environmental rules. At the same time, adding grassroots refining capacity in the U.S. and Europe will prove extremely difficulty in the 1990s, because of overwhelming permitting obstacles. Capacity additions in these two key refining areas are expected to be incremental—"capacity creep."

Although refining capacity is expected to grow outside the U.S. and Europe, especially in the developing nations of the Asia-Pacific region, projections of demand in many of those countries fall short of planned capacity additions.

Together, these trends point to a generally sustained period of high margins and healthy profits for the refining industry in the 1990s.

GAUGER measures contents of storage tanks at Conoco's Lake Charles, La., refinery. (Photo courtesy Conoco).

Refining survey

YOUR USE OF THE INTERNATIONAL REFINING survey may be aided by the following information:

All country-by-country volumes are presented in calendar-day figures except those for the U.S. In that tabulation, only crude is reported in calendar-day figures. Cat cracking and cat reforming are given in stream-day figures.

In the U.S. tabulation, when an asterisk (*) appears beside a number in the crude column, this indicates that the figure was reported as a stream-day figure and has been converted to a calendar-day figure using the crude conversion factor of 0.95.

Calendar-day figures are the average volume a refinery unit processes each day including downtime used for turnarounds. This is actual total volume for the year divided by 365.

Steam-day figures represent the amount a unit can process when running full capacity for short periods.

LEGEND

CAT CRACKING

1. Fluid
2. Other

CAT REFORMING

Semiregenerative:
  1. Conventional catalyst
  2. Bimetallic catalyst

Cyclic:
  3. Conventional catalyst
  4. Bimetallic catalyst

Other:
  5. Conventional catalyst
  6. Bimetallic catalyst

Cat reforming definitions are:

Semiregenerative. Characterized by shutdown to the reforming unit at specified intervals or at the operator's convenience for regeneration of catalyst in situ.

Cyclic. Charactierized by continuous or continual regeneration of catalyst in situ in any one of several reactors that can be isolated from and returned to the reforming operation. This is accomplished without changing feed rate or octane.

Other includes:

Nonregenerative—catalyst replaced by fresh catalyst.

Continuous—continuous regeneration of a part of the catalyst in a special regenerator followed by continuous addition to the reactor.

Moving-bed catalyst systems.

Survey of operating refineries worldwide

(capacities of January 1, 1991)

		b/cd		
Country	No. plants	Crude	Catalytic cracking	Catalytic reforming
Abu Dhabi	2	192,500	....	30,100
Algeria	4	464,700	....	55,600
Angola	1	37,630	....	1,714
Argentina	11	696,285	171,300	41,300
Australia	10	705,500	205,200	160,900
Austria	1	204,000	24,000	32,000
Bahrain	1	243,000	39,000	18,000
Bangladesh	1	31,200	....	1,650
Barbados	1	3,000	....	....
Belgium	4	602,000	104,700	81,900
Bolivia	3	45,250	....	11,300
Brazil	13	1,411,520	316,585	23,610
Brunei	1	10,000	....	....
Cameroon	1	42,000	....	7,000
Canada	28	1,882,060	387,870	367,060
Chile	3	145,800	37,870	10,300
Colombia	4	247,400	91,000	6,000
Congo	1	21,000	....	2,000
Costa Rica	1	15,000	....	1,200
Cyprus	1	18,600	....	4,300
Denmark	3	185,500	....	31,100
Dominican Republic	2	48,000	....	9,100
Ecuador	5	141,800	16,000	2,780
Egypt	8	523,153	....	33,540
El Salvador	1	16,300	....	3,000
Ethiopia	1	18,000	....	2,400
Finland	2	241,000	41,800	42,900
France	14	1,815,630	349,480	246,760
Gabon	1	24,000	....	1,400
Germany	20	2,065,400	240,250	376,500
Ghana	1	26,600	....	6,175
Greece	4	395,300	59,900	47,000
Guatemala	1	16,000	....	3,000
Honduras	1	14,000	....	1,800
Hungary	3	220,000	20,000	23,000
India	12	1,122,360	136,970	28,233
Indonesia	6	813,600	12,600	61,500
Iran	5	720,000	....	105,397
Iraq	8	318,500	....	43,500
Ireland	1	56,000	....	11,000
Israel	2	180,000	22,000	25,000
Italy	21	2,385,358	306,300	315,050
Ivory Coast	2	69,000	....	13,600
Jamaica	1	34,200	....	3,240
Japan	41	4,383,400	629,975	607,970
Jordan	1	100,000	4,250	8,640
Kenya	1	90,000	....	9,000
Korea	6	867,000	....	62,450
Kuwait	4	819,000	42,000	33,000
Lebanon	2	37,500	7,250	7,442
Liberia	1	15,000	....	2,000
Libya	3	347,600	....	13,882
Madagascar	1	16,350	....	2,600
Malaysia	4	209,500	....	30,300
Martinique	1	12,000	....	3,000
Mexico	9	1,679,000	267,000	157,800
Morocco	2	154,600	5,600	26,800
Myanmar	2	32,000	....	....
Netherlands	7	1,196,700	128,000	182,600
Netherlands Antilles	2	470,000	42,000	15,000
New Zealand	1	95,100	....	26,600
Nicaragua	1	16,000	....	3,000
Nigeria	4	433,250	82,700	70,070
Norway	3	288,000	41,000	47,000
Oman	1	76,932	....	15,386
Pakistan	3	120,975	....	4,800
Panama	1	100,000	....	7,500
Paraguay	1	7,500	....	....
Peru	6	188,820	24,600	1,760
Philippines	4	279,300	26,900	37,500
Poland	9	385,454	48,705	42,186
Portugal	3	294,300	10,100	51,000
Puerto Rico	2	125,000	12,000	25,500
Qatar	1	62,000	....	12,030
Saudi Arabia	8	1,862,500	87,541	183,922
Senegal	1	24,000	....	2,600
Sierra Leone	1	10,000	....	....
Singapore	5	878,000	....	63,600
Somalia	1	10,000	....	....
South Africa	4	430,500	84,400	62,600
Spain	10	1,321,000	157,300	191,000
Sri Lanka	1	50,000	....	3,750
Sudan	1	21,700	....	1,900
Sweden	5	427,500	25,000	72,000
Switzerland	2	132,000	....	26,000
Syria	2	237,394	....	31,352
Taiwan	2	542,500	22,600	51,960
Tanzania	1	17,000	....	6,700
Thailand	3	220,550	26,100	27,550
Trinidad	2	246,000	26,000	14,400
Tunisia	1	34,000	....	3,300
Turkey	5	728,644	40,575	66,557
United Kingdom	15	1,866,940	444,500	366,300
Uruguay	1	33,000	4,100	2,500
Venezuela	6	1,167,000	139,000	6,000
Virgin Islands	1	545,000	....	125,000
Yemen	2	171,500	....	13,300
Yugoslavia	7	609,135	52,050	74,612
Zaire	1	17,000	....	3,500
Zambia	1	24,500	....	5,600
Total	**433**	**42,997,790**	**5,064,171**	**5,205,728**

WORLDWIDE REFINING	b/cd		
	Crude capacity	Catalytic cracking	Cat reforming
ABU DHABI			
Abu Dhabi National Oil Co.–Ruwais	120,000	....	[2]19,200
Umm Al-Nar 2	72,500	....	[4]10,900
Total	**192,500**	**....**	**30,100**
ALBANIA			
Government-owned refineries at Ballsh, Cerrik, Stalin.			
Total	**40,000**		
ALGERIA			
Sonatrach: Arzew	60,000	....	8,600
Hassi Messaoud	23,700	....	2,000
Maison Carree	58,000	....	15,000
Skikda	323,000	....	30,000
Total	**464,700**	**....**	**55,600**
ANGOLA			
Fina Petroleos De Angola–Luanda	37,630	....	[1]1,714
Total	**37,630**	**....**	**1,714**
ARGENTINA			
Destileria Argentina de Petróleo SA–Lomas de Zamora	3,585	....	....
Esso SAPA–Campana[1]	93,000	[1]29,600	[2]8,300
Galvan	18,400	....	....
Isaura SA–Bahia Blanca	12,000	....	....
Shell Cia. Argentina de Petróleo SA–Buenos Aires	121,700	[4]29,200	[1]12,000
Sol Petroleo SA—San Francisco Solana, Quilmes	6,000	....	....
Yacimientos Petroliferos Fiscales–Campo Duran	32,000	....	....
Dock Sud	4,000	....	....
La Plata	216,000	[1]71,900	[1]9,000
Lujan de Cuyo	129,000	[1]40,600	[1]9,000
Plaza Huincul	23,000	....	[1]3,000
San Lorenzo	37,600	....	....
Total	**696,285**	**171,300**	**41,300**

Solvent Extract: [1]3,600 b/cd

WORLDWIDE REFINING	b/cd		
	Crude capacity	Catalytic cracking	Cat reforming
AUSTRALIA			
Ampol Refineries Ltd.–Lytton	72,000	[1]28,000	[1]15,000
Australian Lubricating Oil Refinery Ltd.–Kurnell[1]	....	....	....
BP Australia–Brisbane	57,000	[1]17,300	[2]12,200
Kwinana	118,000	[1]28,000	[2]14,000
Caltex Refining CPL–Kurnell	100,000	[1]44,000	[2]24,000
Mobil Oil Australia Ltd.–Adelaide	....	....	....
Petroleum Refineries Australia PL–Adelaide	65,500	....	[2]20,000
Altona	108,000	[2]28,000	[1]31,000
Shell Refining (Australia) PL.–Clyde	75,000	[1]35,000	[2]13,700
Geelong	110,000	[1]25,000	[2]11,000 [6]20,000
Total	**705,500**	**205,300**	**160,900**

Solvent Extract: [1]6,400 b/cd

WORLDWIDE REFINING	b/cd		
	Crude capacity	Catalytic cracking	Cat reforming
AUSTRIA			
OeMV–Schwechat	204,000 [6]6,426	[1]24,000	[2]14,000
Total	**204,000**	**24,000**	**32,000**
BAHRAIN			
Bahrain Petroleum Co. BSC (Closed)–Sitra	243,000	[1]39,000	[2]18,000
Total	**243,000**	**39,000**	**18,000**
BANGLADESH			
Eastern Refinery Ltd.–Chittagong	**31,200**	**....**	**[1]1,650**
BARBADOS			
Mobil Oil Barbados Ltd.–Bridgetown	**3,000**	**....**	**....**
BELGIUM			
Belgian Refining Corp. NV–Antwerp	80,000	....	[3]12,500
Esso Belgium–Antwerp	239,000	[1]28,200	[4]39,200
Nynas Petroleum NV—Antwerp	15,000	....	....
Fina Raffinaderij Antwerpen—Antwerp	268,000	[1]76,500	[2]30,200
Total	**602,000**	**104,700**	**81,900**
BOLIVIA			
Yacimientos Petroliferos Fiscales Bolivianos–Cochabamba[1]	27,250	....	[2]4,900
Santa Cruz	15,000	....	[2]6,400
Sucre	3,000	....	....
Total	**45,250**	**....**	**11,300**

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[1]Solvent extraction: 166 b/cd.

WORLDWIDE REFINING	b/cd		
	Crude capacity	Catalytic cracking	Cat reforming
BRAZIL			
Petróleo Brasileiro SA: Araucária, Paraná[1]	144,800	[1]42,300	...
Betim, Minas Gerais	144,700	[1]32,100	....
Canoas, Rio Grande do Sul	72,400	[1]13,700	....
Capuava, São Paulo	30,200	[2]17,300	....
Cubatão, São Paulo	155,325	[1]50,600	[1]10,500
Duque de Caxias, Rio de Janeiro[2]	209,190	[1]35,815	[1]13,110
Fortaleza, Ceará	....	....	....
Manaus, Amazonas	8,500	[1]1,900	....
Mataripe, Bahia[3]	113,525	[1]25,000	....
Paulínia, São Paulo	289,500	[1]41,600	....
São José dos Campos, São Paulo	215,080	[1]53,770	....
Refinaria de Petróleo Ipiranga SA–Rio Grande do Sul	9,300	[1]2,500	....
Refinaría de Petroleos de Manguinhos SA–Rio de Janeiro	10,000 [3]4,400	....	....
Total	**1,411,520**	**316,585**	**23,610**

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[1]Solvent extraction: 27,800 b/cd. [2]30,200 b/cd. [3]3,400 b/cd.

WORLDWIDE REFINING	Crude capacity (b/cd)	Catalytic cracking (b/cd)	Cat reforming (b/cd)

BRUNEI

WORLDWIDE REFINING	Crude capacity	Catalytic cracking	Cat reforming
Brunei Shell Petroleum CL–Seria	**10,000**	....	....

BULGARIA

Government-owned refineries at Burgas, Pleven, Ruse.

WORLDWIDE REFINING	Crude capacity	Catalytic cracking	Cat reforming
Total	**300,000**		

CAMEROON

WORLDWIDE REFINING	Crude capacity	Catalytic cracking	Cat reforming
Sonara–National Refining CL–Cape Limboh, Limbe	**42,000**	....	**[2]7,000**

CANADA

WORLDWIDE REFINING	Crude capacity	Catalytic cracking	Cat reforming
Alberta			
Husky Oil Operations Ltd.–Lloydminster	23,500	....	....
Imperial Oil Ltd.–Edmonton	164,900	[1]47,000	[4]20,900
Parkland Refining Ltd.–Bowden	6,700	....	[1]3,000
Petro-Canada Products Inc.–Edmonton	115,500	[1]33,300	[2]9,000
Shell Canada Ltd.–Scotford	56,810	....	[6]20,425
Turbo Resources Ltd.–Balzac	27,500	[1]11,570	[2]7,550
Total	**394,910**	**91,870**	**60,875**
British Columbia			
Chevron Canada Ltd.–North Burnaby	45,000	[1]10,500	[2]10,000
Husky Oil Operations Ltd.–Prince George	9,500	[1]3,300	[2]1,400
Imperial Oil Ltd.–Ioco	42,800	[1]12,300	[4]7,000
Petro-Canada Products Inc.–Port Moody	25,500	....	[2]8,600
Taylor	15,500	[1]6,300	[2]3,000
Shell Canada Ltd.–Shellburn, Burnaby	22,800	[1]5,320	[2]3,420
Total	**161,100**	**37,720**	**33,420**
New Brunswick			
Irving Oil Ltd.–St. John	237,500	[1]17,100	[2]34,650
Total	**237,500**	**17,100**	**34,650**
Newfoundland			
Newfoundland Processing Ltd.–Come By Chance	**105,000**	....	**[2]26,000**
Northwest Territories			
Imperial Oil Ltd.–Norman Wells	**3,500**	....	....
Nova Scotia			
Imperial Oil Ltd.–Dartmouth	82,300	[1]23,000	[4]9,500
McColl Frontenac Inc.–Halifax	20,000	[1]7,200	[2]3,600
Total	**102,300**	**30,200**	**13,100**
Ontario			
Imperial Oil Ltd.–Nanticoke	106,400	[1]37,600	[6]24,700
Sarnia	122,600	[1]25,000	[2]13,300 [4]14,300
Petro-Canada Products Inc.–Clarkson	41,500	....	[6]9,800
Oakville	80,500	[1]25,400	[2]13,200
Shell Canada Ltd.–Sarnia	67,450	[1]13,680	[2]19,950
Suncor Inc.–Sarnia	83,000	[2]16,300	[2]26,700
Total	**501,450**	**117,980**	**121,950**
Quebec			
Petro-Canada Products Inc.–Montreal	87,400	[1]17,200	[2]31,300
Shell Canada Ltd.–Montreal	114,000	[1]20,900	[2]19,665
Ultramar Canada Inc.–St. Romuald	116,400	[1]37,300	[2]17,100
Total	**317,800**	**75,400**	**68,065**
Saskatchewan			
Consumers' Cooperative Refineries Ltd.–Regina	45,200	[1]17,600	[2]9,000
Producers Pipeline–Moose Jaw	13,300	....	....
Total	**58,500**	**17,600**	**9,000**
Total Canada	**1,882,060**	**387,870**	**367,060**

CHILE

WORLDWIDE REFINING	Crude capacity	Catalytic cracking	Cat reforming
ENAP–Gregorio-Magallanes	8,800	....	....
Petrox SA–Talcahuano	72,000	[1]18,870	[2]4,500
Refinería de Concón–Concón	65,000	[1]19,000	[2]5,800
Total	**145,800**	**37,870**	**10,300**

CHINA

Government-owned refineries at Anshan, Beijing, Dalian, Daqing, Fushun, Hangzhou, Jinxi, Karamai-Dushanzi, Lanchow, Lenghu, Maoming, Nanchong, Nanjing, Shanghai, Shengli, Tianjin, Yumen.

WORLDWIDE REFINING	Crude capacity	Catalytic cracking	Cat reforming
Total	**2,200,000**		

COLOMBIA

WORLDWIDE REFINING	Crude capacity	Catalytic cracking	Cat reforming
Empresa Colombiana de Petróleos–Barrancabermeja-Santander[1]	170,000	[1]62,000	[2]6,000
Cartagena, Bolivar	70,000	[1]29,000	....
Orito, Putumayo	2,400	....	....
Tibu, N. de Santander	5,000	....	....
Total	**247,400**	**91,000**	**6,000**

Solvent extraction: [1]35,000 b/cd.

CONGO

WORLDWIDE REFINING	Crude capacity	Catalytic cracking	Cat reforming
Coraf–Pointe-Noire	**21,000**	....	**[2]2,000**

COSTA RICA

WORLDWIDE REFINING	Crude capacity	Catalytic cracking	Cat reforming
Refinadora Costarricense de Petroleo SA–Limón	**15,000**	....	**[2]1,200**

CUBA

Government-owned refineries at Cabaiguan, Cienfuegos, Havana, Santiago de Cuba.

WORLDWIDE REFINING	Crude capacity	Catalytic cracking	Cat reforming
Total	**280,000**		

CYPRUS

WORLDWIDE REFINING	Crude capacity	Catalytic cracking	Cat reforming
Cyprus Petroleum Refinery Ltd.–Larnaca	**18,600**	....	**[2]4,300**

CZECHOSLOVAKIA

Government owned refineries at Kolin, Pardubice, Strazke, Zaluzi, Zvolen

WORLDWIDE REFINING	Crude capacity	Catalytic cracking	Cat reforming
Crude capacity	240,200		
Kaucuk s.p.–Kralupy	64,800	....	[2]7,500
Slovnaft s.p.–Bratislava[1]	150,000	....	[2]22,700
Total	**455,000**	....	**30,200**

Solvent extraction: [1]700 b/cd.

DENMARK

WORLDWIDE REFINING	Crude capacity	Catalytic cracking	Cat reforming
AS Dansk Shell–Fredericia	62,000	....	[2]12,000
Statoil AS–Kalundborg	65,000	....	[2]8,600
Kuwait Petroleum Refining (Danmark) A/S–Skaelskoer	58,500	....	[2]10,500
Total	**185,500**	....	**31,100**

DOMINICAN REPUBLIC

WORLDWIDE REFINING	Crude capacity	Catalytic cracking	Cat reforming
Falconbridge Dominicana C por A–La Bonao	16,000	....	....
Refineria Dominicana de Petróleo SA–Haina	32,000	....	[1]9,100
Total	**48,000**	....	**9,100**

ECUADOR

WORLDWIDE REFINING	Crude capacity	Catalytic cracking	Cat reforming
CEPE–Esmeraldas	90,000	[1]16,000	[2]2,780
Sta. Elena Peninsula	32,300	....	....
Refieria Amazonas	10,000	....	....
Repetrol–Santa Elena	8,500	....	....

WORLDWIDE REFINING	Crude capacity (b/cd)	Catalytic cracking (b/cd)	Cat reforming (b/cd)
Texaco–Lago-Agrio	1,000	....	....
Total	**141,800**	**16,000**	**2,780**

EGYPT

WORLDWIDE REFINING	Crude capacity (b/cd)	Catalytic cracking (b/cd)	Cat reforming (b/cd)
Alexandria Petroleum Co.–Alexandria–(El-Mex)	97,850	....	....
Cairo Oil Refining Co.–Mostorod	156,750	....	^{2}9,000
Tanta	21,800	....	....
Amerya Oil Refining Co.–Alexandria	64,000	....	^{2}12,000
El-Nasr Petroleum Co.–El-Suez	58,400	....	....
Wadi-Feran	9,680	....	....
Suez Oil Processing Co.–El-Suez	62,530	....	^{2}12,540
Assiout	52,143	....	....
Total	**523,153**	**....**	**33,540**

EL SALVADOR

WORLDWIDE REFINING	Crude capacity (b/cd)	Catalytic cracking (b/cd)	Cat reforming (b/cd)
Refinería Petrólera Acajutla SA–Acajutla	16,300	....	^{1}3,000
Total	**16,300**	**....**	**3,000**

ETHIOPIA

WORLDWIDE REFINING	Crude capacity (b/cd)	Catalytic cracking (b/cd)	Cat reforming (b/cd)
Ethiopian Petroleum Corp.–Assab	**18,000**	**....**	**^{3}2,400**

FINLAND

WORLDWIDE REFINING	Crude capacity (b/cd)	Catalytic cracking (b/cd)	Cat reforming (b/cd)
Neste Oy–Naantali	44,000	^{2}13,300	^{5}6,800
Porvoo	197,000	^{1}28,500	^{5}36,100
Total	**241,000**	**41,800**	**42,900**

FRANCE

WORLDWIDE REFINING	Crude capacity (b/cd)	Catalytic cracking (b/cd)	Cat reforming (b/cd)
CRD—Total France–Gonfreville L'Orcher^{1}	309,000	^{1}31,500	^{2}45,400
La Mède	136,000	^{1}29,700	^{4}23,400
Mardyck	122,000	^{1}29,800	^{4}20,500
Cie. Rhénane de Raffinage–Reichstett-Vendenheim	80,000	^{1}13,760	^{1}12,900
Elf France–Donges	200,000	^{1}66,000	^{2}25,600
Feyzin	120,000	^{1}22,700	^{2}8,600
Grandpuits	92,000	^{1}28,800	^{2}12,900
Esso SAF–Fos sur Mer	100,000	^{1}22,000	^{1}16,000
Port Jerome	136,000	^{1}24,000	^{1}16,000
Mobil Oil Francaise–Notre Dame de Gravenchon	57,000	....	^{2}13,300
Shell Francaise–Berre l'Etang	128,000	^{1}38,000	^{2}19,000
Petit Couronne	158,000	^{1}20,000	^{2}28,000
Ste. Francaise des Petroles BP–Dunkirk	....	....	....
Lavera	177,630	^{1}23,220	^{1}5,160
Total	**1,815,630**	**349,460**	**246,760**

Solvent extraction: ^{1}9,800 b/cd.

GABON

WORLDWIDE REFINING	Crude capacity (b/cd)	Catalytic cracking (b/cd)	Cat reforming (b/cd)
Ste. Gabonaise de Raffinage–Port Gentil	**24,000**	**....**	**^{3}1,400**

GERMANY

WORLDWIDE REFINING	Crude capacity (b/cd)	Catalytic cracking (b/cd)	Cat reforming (b/cd)
Addinol Mineralol GmbH Lutzkendorf—Krumpa, Kreis Merseburg^{1}	16,500	....	....
BP Oiltech Gmbh—Hamburg	....	....	....
DEA Mineraloel AG–Heide	80,000	^{1}9,000	^{4}20,000
UK-Wesseling	100,000	....	^{4}19,000
DMP Mineralol Petrochemie GmbH–Burghausen	72,000	....	....
Deutsche Shell AG–Godorf	170,000	....	^{2}17,000 ^{6}21,000
Harburg-Grasbrook	86,000	^{1}15,000	^{6}16,000
Erdoel Raffinerie Neustadt GmbH–Neustadt-Donau	144,000	^{1}26,000	^{1}17,700
Esso AG–Ingolstadt	95,000	^{1}24,500	^{2}15,600
Karlsruhe	150,000	....	^{2}28,000
Holborn Europa Raffinerie GmbH—Harburg	78,000	^{1}18,750	^{2}14,700
Hydrierwerk Zeitz GmbH–Zeitz	73,700	....	....
Leune-Werke AG–Leuna	100,000	....	^{2}15,000
Mobil Oil AG–Woerth	93,000	^{1}19,000	^{2}15,900
Oberrheinische Mineralolwerke GmbH–Karlsruhe	174,000	^{1}66,000	^{2}11,400 ^{6}21,300
PCK Schwedt AG–Schwedt	230,000	^{1}37,000	^{2}23,000 ^{6}18,000
Raffineriegesellschaft–Vohburg/Ingolstadt	120,000	^{1}19,000	^{2}18,000 ^{6}18,800
Ruhr Oel GmbH–Gelsenkirchen	215,400	^{1}6,000	^{1}11,900 ^{5}27,000
Wintershall AG–Lingen	65,000	....	^{2}12,200 ^{4}15,000
Salzbergen	2,800	....	....
Total	**2,065,400**	**240,250**	**376,500**

Solvent extraction: ^{1}5,000 b/cd.
Note: Some of the smaller east german refineries are not accounted for.

GHANA

WORLDWIDE REFINING	Crude capacity (b/cd)	Catalytic cracking (b/cd)	Cat reforming (b/cd)
Ghanaian Italian Petroleum CL–Tema	**26,600**	**....**	**^{2}6,175**

GREECE

WORLDWIDE REFINING	Crude capacity (b/cd)	Catalytic cracking (b/cd)	Cat reforming (b/cd)
Hellenic Aspropyrgos Refinery SA–Aspropyrgos	120,800	^{1}32,600	^{2}9,800 ^{6}20,600
Motor Oil (Hellas) Corinth Refineries SA–Aghii Theodori	100,000	^{1}27,300	^{2}8,500
Petrola Hellas SA–Elefsis	108,000	....	....
Thessaloniki Refining Co. AE–Thessaloniki	66,500	....	^{2}8,100
Total	**395,300**	**59,900**	**47,000**

GUATEMALA

WORLDWIDE REFINING	Crude capacity (b/cd)	Catalytic cracking (b/cd)	Cat reforming (b/cd)
Texas Petroleum Co.–Escuintla	16,000	....	^{2}3,000
Total	**16,000**	**....**	**3,000**

HONDURAS

WORLDWIDE REFINING	Crude capacity (b/cd)	Catalytic cracking (b/cd)	Cat reforming (b/cd)
Refineria Texas de Honduras SA–Puerto Cortes	14,000	....	^{1}1,800
Total	**14,000**	**....**	**1,800**

HUNGARY

WORLDWIDE REFINING	Crude capacity (b/cd)	Catalytic cracking (b/cd)	Cat reforming (b/cd)
Dunai KV–Százhalombatta	150,000	^{1}20,000	^{2}23,000
Tiszai KV–Leninváros	60,000	....	....
Zalai KV–Zalaegerszeg	10,000	....	....
Total	**220,000**	**20,000**	**23,000**

INDIA

WORLDWIDE REFINING	Crude capacity (b/cd)	Catalytic cracking (b/cd)	Cat reforming (b/cd)
Bharat Petroleum CL–Mahul, Bombay	156,600	^{1}33,800	^{1}5,400
Bongaigaon Refinery & Petrochemicals Ltd.–Bongaigaon, Assam	27,610	....	^{2}1,833
Cochin Refineries Ltd.–Ambalamugal	90,000	^{1}20,000	^{1}5,000
Hindustan Petroleum CL–Mahul, Bombay^{1}	111,650	^{1}12,000	....
Visakhapatnam	90,000	^{1}19,200	....
Indian Oil CL–Barauni, Bihar^{2}	70,200	....	....
Digboi, Assam	11,700	....	....
Guwahati, Assam	18,100	....	....
Koyali, Gujarat	205,700	^{1}20,100	^{2}8,300
Haldia, West Bengal^{3}	61,100	....	^{1}5,300
Mathura, Uttar Pradesh	165,000	^{1}20,100	....
Madras Refineries Ltd.–Madras	114,700 ^{3}3,000	^{1}11,770	^{1}2,400
Total	**1,122,360**	**136,970**	**28,233**

Solvent extraction: ^{1}10,000 b/cd, ^{2}4,000 b/cd, ^{3}16,000 b/cd.

INDONESIA

WORLDWIDE REFINING	Crude capacity (b/cd)	Catalytic cracking (b/cd)	Cat reforming (b/cd)
Pertamina–Balikpapan, Kalimantan	231,500	....	^{6}18,000
Cilacap, Central Java	300,400	....	^{1}12,000 ^{6}18,000
Dumai, Central Sumatra	114,400	....	^{1}5,600 ^{6}7,900

	b/cd		
WORLDWIDE REFINING	Crude capacity	Catalytic cracking	Cat reforming
Musi, South Sumatra	114,300	[1]12,600	....
Pangakalan Brandan, North Sumatra	5,000	....	....
Sungai Pakning, Central Sumatra	48,000	....	....
Total	**813,600**	**12,600**	**61,500**
IRAN			
National Iranian Oil Co.–			
Abadan	190,000	....	[6]41,555
Esfahan	200,000	....	[6]29,600
Shiraz	40,000	....	[5]6,245
Tabriz	80,000	....	....
Tehran	210,000	....	[6]28,000
Total	**720,000**	**....**	**105,400**
IRAQ			
Oil Refineries Administration–Baiji	150,000	....	22,000 16,500
Basra	70,000	....	....
Daura	71,000	....	5,000
K3-Haditha	7,000	....	....
Khanaqin	12,000	....	....
Mufthia	4,500	....	....
Qaiyarah, Mosul	2,000	....	....
Iraqi Company for Oil Operations–			
Kirkuk	2,000	....	....
Total	**318,500**	**....**	**43,500**

Present status uncertain due to Middle East crisis.

IRELAND			
Irish National Refining plc–			
Whitegate	**56,000**	....	**[4]11,000**
ISRAEL			
Oil Refineries Ltd.–Ashdod	70,000	....	[2]10,000
Haifa	110,000	[1]22,000	[2]15,000
Total	**180,000**	**22,000**	**25,000**
ITALY			
Agip Plas SpA–Livorno	84,000	....	[2]9,500 [6]12,000
Agip Raffinazione SpA–			
Porto Marghera	70,000	....	[2]15,000
Rho, Milan	80,000	[1]14,300	[2]17,000
Sannazzaro, Pavia	200,000	[1]30,000	[2]12,000
Taranto	84,000 [3]37,250	....	[2]17,000
Anonima Petroli Italiana–Falconara, Marittima	63,000	....	[2]11,000
Arcola Petrolifera SpA–La Spezia	17,358	....	....
Esso Italiana SpA–			
Augusta, Siracusa	180,000	[1]45,300	[2]22,300
Industrie Chimiche Italiane de Petrolio SpA-Frassino, Mantova	55,000	....	[2]7,000
Iplom SpA–Busalla	46,500	....	....
Isab–Priolo Gargallo	220,000	....	[4]34,500
Kuwait Raffinazione E Chimica–			
Naples	100,000	[2]20,000	[2]26,000
Raffineria di Roma SpA–Rome	81,500	....	[2]14,200
Raffineria Mediterranea Spa–			
Milazzo	160,000	[1]40,000	[2]12,000
Raffineria Siciliana SrL–Gela	105,000	[1]35,000	[2]13,850
Saras SpA–Sarroch	285,000	[1]72,000	[5]27,000
Sarpom–S. Martino Di Trecate	219,000	[1]17,700	[2]18,500 [4]8,100
ENI–Priolo	240,000	[1]32,000	[2]9,000
Tamoil Italia SpA–Cremona	95,000	....	[2]12,400
Total	**2,385,358**	**306,300**	**315,050**
IVORY COAST			
Ste. Ivoirienne de Raffinage–			
Abidjan	59,000	....	[2]13,600
Ste. Multinationale de Bitumes—			
Abidjan	10,000	....	....
Total	**69,000**	**....**	**13,600**

	b/cd		
WORLDWIDE REFINING	Crude capacity	Catalytic cracking	Cat reforming
JAMAICA			
Petrojam Ltd.–Kingston	34,200	....	[1]3,240
Total	**34,200**	**....**	**3,240**
JAPAN			
Cosmo Oil CL–Chiba	209,000	[1]30,400	[2]34,675
Sakaide	133,000	[1]16,150	[2]9,500
Sakai	104,500	[1]18,525	[2]6,650
Yokkaichi City	166,250	[1]23,750	[2]5,700 [4]10,450
Fuji Oil CL–Sodegaura,Chiba	126,600	[1]14,000	[2]16,300
General Sekiyu Seisei KK–Sakai	131,400	[1]32,500	[2]26,100
Idemitsu Kosan CL–Chita, Aichi	123,500	[1]27,000	[5]16,200
Himeji, Hyogo	104,500	....	[2]12,600
Ichihara, Chiba	199,500	[1]37,800	[2]15,300
Tokuyama, Yamaguchi	95,000	[1]20,700	....
Tomakomai, Hokkaido	85,500	....	[2]16,200
Kainan Petroleum Refining CL—			
Kaiwan City, Wakayama	64,000	....	....
Kashima Oil CL–Kashima, Ibaragi	150,000	[1]17,500	[2]7,500 [5]14,000
Koa Oil CL–Marifu	110,000	[1]20,000	[2]11,000
Osaka	80,000	[1]23,500	[2]11,000
Kyenus Sekiyu Seisei KK–			
Kawasaki	66,500	....	....
Kyokuto Petroleum Ltd.–Chiba	125,000	....	[2]20,000
Kyushu Oil CL–Oita	130,000	[1]16,500	[2]8,000
Mitsubishi Oil CL–Kawasaki	55,000	....	[2]10,000
Mizushima	220,000	[1]34,000	[2]25,000 [6]18,500
Nansei Sekiyu KK–Nishihara, Okinawa	54,000	....	[2]8,600
Nihonkai Oil CL–Toyama	43,700	....	[2]4,950
Nippon Mining CL–Chita	85,000	[1]13,000	[2]22,000
Funakawa	6,000	....	....
Mizushima[1]	190,200	[1]38,000	[2]20,000
Nippon Oil CL–Niigata	26,000	[2]4,000	....
Nippon Petroleum Refining CL–			
Muroran	150,000	[1]21,000	[2]21,000
Nakagusuku, Okinawa	....	....	[2]2,500
Negishi	305,000	[1]39,000	[2]20,000 [6]30,000
Yokohama	....	....	[2]1,300
Okinawa Sekiyu Seisei–			
Yonashiro, Okinawa	57,000	....	....
Seibu Oil CL–Yamaguchi	110,100	[1]19,900	[2]20,000
Showa Shell Sekiyu KK–Kawasaki	96,400	....	[2]13,800
Niigata	27,500	....	[2]4,300
Showa Yokkaichi Sekiyu CL–			
Yokkaichi	165,200	[1]22,600	[2]40,600
Taiyo Oil CL–Ehime	61,750	....	[1]5,700
Tonen Corp.–Kawasaki	190,000	[1]74,100	[2]18,600 [4]22,320
Wakayama	157,700	[1]34,200	[2]34,875
Toa Oil CL–Kawasaki	59,700	[1]27,100	[2]7,100
Toho Oil CL–Owase	35,000	....	....
Tohoku Oil CL–Sendai	83,900	....	[2]12,000
Total	**4,383,400**	**629,975**	**607,970**

Solvent extraction: [1]9,000 b/cd.

JORDAN			
Jordan Petroleum Refinery–Zerka	100,000	[1]4,250	[2]8,640
Total	**100,000**	**4,250**	**8,640**
KENYA			
Kenya Petroleum Refineries Ltd.–			
Mombasa	90,000	....	[1]3,800 [2]5,200
Total	**90,000**	**....**	**9,000**
KOREA, N.			
Government-owned, Unggi	**42,000**		
KOREA, S.			
Honam Oil Refinery CL–Yocheon	342,000	....	[2]15,300

WORLDWIDE REFINING	b/cd Crude capacity	Catalytic cracking	Cat reforming
Kukdong Oil CL–Busan[1]	10,000	....	....
Daesan	60,000	....	[2]3,000
Kyung In Energy CL–Inchon	60,000	....	[2]3,600
Ssangyong Oil Refining CL–Onsan[2]	90,000	....	[1]4,000
Yukong Ltd.–Ulsan	305,000	....	[2]17,650 [6]18,900
Total	**867,000**	**....**	**52,450**
Solvent extraction: [1]2,100 b/d. [2]8,000 b/d.			
KUWAIT			
Getty Oil Co. (subsidiary of Texaco Inc.)–Mina Al-Zour	72,000	....	....
Kuwait National Petroleum Co. –Mina Abdulla	190,000	....	....
Mina Al-Ahmadi	370,000	[1]28,000	[2]33,000
Shuaiba	187,000	[2]14,000	....
Total	**819,000**	**42,000**	**33,000**
Present status unclear due to Middle East Crisis.			
LEBANON			
Tripoli Oil Installations–Tripoli	20,000	[1]7,250	[2]4,392
Zahrani Oil Installations–Sidon	17,500	....	[1]3,050
Total	**37,500**	**7,250**	**7,442**
LIBERIA			
Liberia Petroleum Refining–Monrovia	15,000	....	[1]2,000
Total	**15,000**	**....**	**2,000**
LIBYA			
Azzawiya Oil Refining Co.–Azzawiya	120,000	....	[2]12,982
Ras Lanuf Oil & Gas Processing Co.–Ras Lanuf	220,000	....	....
Sirte Oil Co.–Brega	7,600	....	[1]900
Total	**347,600**	**....**	**13,8[illegible]**
MADAGASCAR			
Solima–Managareza, Tamatave	**16,350**	**....**	**[1]2,600**
MALAYSIA			
Esso Malaysia Berhad–Port Dickson	47,500	....	[2]13,300
Petronas Penapisan Sdn. Berhad –Kerteh, Kemaman, Terengganu	27,000	....	....
Sarawak Shell Berhad–Luton	45,000	....	....
Shell Refining Co. Berhad–Port Dickson	90,000	....	[1]4,000 [4]13,000
Total	**209,500**	**....**	**30,300**
MARTINIQUE			
Ste. Anonyme de la Raffinerie des Antilles–Fort-de-France	12,000	....	[2]3,000
Total	**12,000**	**....**	**3,000**
MEXICO			
Petroleos Mexicanos–Azcapotzalco	105,000	[1]24,000	....
Cadereyta	235,000	[1]40,000	[2]20,000
Ciudad Madero[1]	195,000	[1]43,000	[2]15,000
Minatitlan	200,000	[1]24,000 [2]16,000	[2]48,000
Poza Rica	50,000	....	....
Reynosa	9,000	....	....
Salamanca	235,000	[1]40,000	[2]24,800
Salina Cruz	330,000	[1]40,000	[6]20,000
Tula, Hidalgo	320,000	[1]40,000	[2]30,000
Total	**1,679,000**	**267,000**	**157,800**
Solvent extraction: [1]38,000 b/cd.			

WORLDWIDE REFINING	b/cd Crude capacity	Catalytic cracking	Cat reforming
MOROCCO			
Samir–Mohammedia	129,000	....	[2]24,000
Ste. Cherifienne des Petroles –Sidi Kacem	25,600	[2]5,600	[1]2,800
Total	**154,600**	**5,600**	**26,800**
MYANMAR			
Myanma Petrochemical Enterprise–Chauk	6,000	....	....
Thanlyin	26,000	....	....
Total	**32,000**	**....**	**....**
Formerly Burma			
NETHERLANDS			
Esso Nederland BV–Rotterdam	153,200	....	[4]26,600
Kuwait Petroleum Europoort BV–Rotterdam[1]	75,500	....	[4]19,000
Netherlands Refining Co.–Europoort & Pernis	460,000	[1]50,000	[2]58,000
Shell Nederland Raffinaderij BV–Pernis	348,000	[1]78,000	[2]17,000 [6]42,000
Smid & Hollander Raffinaderij BV–Amsterdam	10,000	....	....
Total Raffinaderij Nederland NV–Vlissingen	150,000	....	[3]20,000
Total	**1,196,700**	**128,000**	**182,600**
Solvent extraction: [1]3,200 b/cd.			
NETHERLANDS ANTILLES			
Refineria Isla Curazao SA–Emmastad	320,000	[1]42,000	[2]15,000
Coastal Aruba Refining Co. N.V.–San Nicolas	150,000	....	....
Total	**470,000**	**42,000**	**15,000**
NEW ZEALAND			
New Zealand Refining–Whangarei[1]	95,100	....	[2]26,600
Total	**95,100**	**....**	**26,600**
Solvent extraction: [1]10,000 b/cd.			
NICARAGUA			
Esso Standar[illegible] SA Ltd.–Managua	16,000	....	[1]3,000
Total	**16,000**	**....**	**3,000**
NIGERIA			
Kaduna Refinery & Petrochemical Co. (NNPC)–Kaduna[1]	104,500	[1]18,000	[2]15,300
Port Harcourt Refining Co. (NNPC)–Alesa Eleme	60,000	....	[1]6,000
Rivers State	150,000	[1]40,000	[6]33,000
Warri Refinery & Petrochemical Co. (NNPC)–Warri	118,750	[1]24,700	[2]15,770
Total	**433,250**	**82,700**	**70,070**
Solvent extraction: [1]9,492 b/cd. †Dimersol			
NORWAY			
Esso Norge AS–Slagen-Toensberg	90,000	....	[2]10,000
Norske Shell AS–Sola	53,000	....	[2]11,000
Statoil Division Mongstad–Mongstad	145,000	[2]41,000	[2]10,000 [5]16,000
Total	**288,000**	**41,000**	**47,000**
OMAN			
Oman Refinery Co –Mina Al Fahal	**78,932**	**....**	**[2]15,386**

PAKISTAN

WORLDWIDE REFINING	b/cd Crude capacity	Catalytic cracking	Cat reforming
Attock Refinery Ltd.–Rawalpindi	30,500	....	....
National Refinery Ltd.–Korangi, Karachi[1]	44,175	....	[2]2,100
Pakistan Refinery Ltd.–Karachi	46,300	....	[4]2,700
Total	**120,975**	**....**	**4,800**

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[1] Solvent Extraction: 5,605

PANAMA

WORLDWIDE REFINING	b/cd Crude capacity	Catalytic cracking	Cat reforming
Refinería Panama SA–Las Minas	100,000	....	[2]7,500
Total	**100,000**	**....**	**7,500**

PARAGUAY

WORLDWIDE REFINING	b/cd Crude capacity	Catalytic cracking	Cat reforming
Petroleos Paraguayos–Villa Elisa	**7,500**	**....**	**....**

PERU

WORLDWIDE REFINING	b/cd Crude capacity	Catalytic cracking	Cat reforming
Petróleos del Peru:			
Conchan	6,300	....	....
Iquitos, Loreto	10,500	....	....
La Pampilla, Lima	105,000	[1]8,000	[1]1,760
Marsella, Loreto	2,170	....	....
Pucallpa	2,850	....	....
Talara	62,000	[1]16,600	....
Total	**188,820**	**24,600**	**1,760**

PHILIPPINES

WORLDWIDE REFINING	b/cd Crude capacity	Catalytic cracking	Cat reforming
Caltex (Philippines) Inc.–Batangas	58,500	[1]11,900	[2]5,700
Petron Corp.–Limay, Bataan	155,000	[2]15,000	[1]6,800 [2]17,000
Philippine Petroleum Corp.–Pililla	....	....	....
Pilipinas Shell Petroleum–Tabangao	65,800	....	[1]8,000
Total	**279,300**	**26,900**	**37,500**

POLAND

Government-owned refineries at Czechowice, Glinik Mariampolski, Jasto, Jealicze, Kralaty, L. Warynski, Trzebinia.

WORLDWIDE REFINING	b/cd Crude capacity	Catalytic cracking	Cat reforming
Crude capacity	73,000		
Mazovian Refinery & Petrochemical Works–Plock	252,454	[1]48,705	[2]31,186
Petroleum Refinery Gdansk—Gdansk[1]	60,000	....	[4]11,000
Total	**385,454**	**48,705**	**42,186**

Solvent extraction: [1]6,800 b/cd.

PORTUGAL

WORLDWIDE REFINING	b/cd Crude capacity	Catalytic cracking	Cat reforming
Petrogal–Lisboa	....	[2]10,100	....
Leça da Palmeira, Porto	88,300	....	[2]15,600 [4]10,500
Sines	206,000	....	[6]24,900
Total	**294,300**	**10,100**	**51,000**

PUERTO RICO

WORLDWIDE REFINING	b/cd Crude capacity	Catalytic cracking	Cat reforming
Caribbean Petroleum Corp.–Bayamón	40,000	[1]12,000	[2]6,500
Puerto Rico Sun Oil Co.–Yabucoa	85,000	....	[2]19,000
Total	**125,000**	**12,000**	**25,500**

QATAR

WORLDWIDE REFINING	b/cd Crude capacity	Catalytic cracking	Cat reforming
National Oil Distribution Co.–Umm Said	62,000	....	[2]2,200 [6]9,830
Total	**62,000**	**....**	**12,030**

ROMANIA

Government-owned refineries at Bacau, Borzesti, Brazi, Brazov, Cimpina, Darmanesti, G. Gheorghiu Dej, Navodari, Onesti, Pitesti, Ploesti, Sulpacu, and Telaejen.

WORLDWIDE REFINING	b/cd Crude capacity	Catalytic cracking	Cat reforming
Total	**617,000**		

SAUDI ARABIA

WORLDWIDE REFINING	b/cd Crude capacity	Catalytic cracking	Cat reforming
Saudi Arabian Oil Co. (Saudi Aramco)–Ras Tanura	530,000	....	[2]50,000
Arabian Oil CL–Ras Al Khafji	30,000	....	....
Jeddah Oil Refinery–Jeddah	82,000	[1]9,041	[2]2,622
Petromin-Mobil–Yanbu	300,000	[1]78,500	[5]43,300
Petromin Petrola Rabigh Refinery Co.—Rabigh	332,500	....	....
Petromin-Shell–Al-Jubail[1]	284,000	....	[6]19,000
Riyadh Oil Refinery–Riyadh[2]	134,000		....
Yanbu Petromin Refinery–Yanbu	170,000	....	[2]35,000
Total	**1,862,500**	**87,541**	**183,922**

Solvent extraction: [1]14,000 b/cd. [2]8,800 b/cd.

SENEGAL

WORLDWIDE REFINING	b/cd Crude capacity	Catalytic cracking	Cat reforming
Ste. Africaine de Raffinage–M'Bao (Dakar)	**24,000**	**....**	**[4]2,600**

SIERRA LEONE

WORLDWIDE REFINING	b/cd Crude capacity	Catalytic cracking	Cat reforming
Sierra Leone Petroleum Refining Co.–Freetown	**10,000**	**....**	**....**

SINGAPORE

WORLDWIDE REFINING	b/cd Crude capacity	Catalytic cracking	Cat reforming
BP Refinery Singapore PL–Pasir Panjang	28,000	....	....
Esso Singapore PL–Pulau Ayer Chawan	190,000	....	[2]11,400
Mobil Oil Singapore PL–Jurong	223,000	....	[2]18,000
Shell Eastern Petroleum Ltd.–Pulau Bukom	258,000	....	[2]6,800 [6]13,900
Singapore Petroleum CPL†–Pulau Merlimau	179,000	....	[4]13,500
Total	**878,000**	**....**	**63,600**

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†Singapore Petroleum CPL shares percentages of refinery capacities.

SOMALIA

WORLDWIDE REFINING	b/cd Crude capacity	Catalytic cracking	Cat reforming
Iraqsoma Ref. Co.–Mogadishu	**10,000**	**....**	**....**

SOUTH AFRICA

WORLDWIDE REFINING	b/cd Crude capacity	Catalytic cracking	Cat reforming
Caltex Oil SA PL–Cape Town	90,000	[1]25,000	[2]10,500
Gencor–Durban	65,000	[1]15,000	[2]15,000
National Petroleum Refiners of South Africa PL–Sasolburg OFS	75,500	[1]17,400	[2]11,100
Shell and BP South Africa Petroleum Refineries PL–Durban	200,000	[1]27,000	[2]26,000
Total	**430,500**	**84,400**	**62,600**

SPAIN

WORLDWIDE REFINING	b/cd Crude capacity	Catalytic cracking	Cat reforming
Asfaltos Españoles SA–Tarragona	21,000	....	....
Cia. Española de Petróles–San Roque (Cádiz)	160,000	[1]36,000	[2]35,000
Tenerife	130,000	....	[2]14,000
Ertoil, SA–La Rábida, Huelva	80,000	....	[2]14,100
Petrómed—Castellón de la Plana	120,000	[1]23,300	[2]13,400
Petronor SA–Somorrostro, Vizcaya	240,000	[1]40,000	[2]33,500
Repsol Petroleo SA–Cartagena, Murcia	120,000	....	[2]25,000
La Coruña	135,000	[1]28,000	[2]22,000
Puertollano, Ciudad Real	135,000	[1]30,000	[2]18,000
Tarragona	180,000	....	[2]16,000
Total	**1,321,000**	**157,300**	**191,000**

SRI LANKA

WORLDWIDE REFINING	b/cd Crude capacity	Catalytic cracking	Cat reforming
Ceylon Petroleum Corp.–Sapugaskanda	50,000	....	[2]3,750
Total	**50,000**	**....**	**3,750**

WORLDWIDE REFINING	b/cd Crude capacity	b/cd Catalytic cracking	b/cd Cat reforming
SUDAN			
Port Sudan Refinery Ltd.–Port Sudan	**21,700**	**....**	**[1]1,900**
SWEDEN			
AB Nynas Petroleum–Gothenburg	12,500	....	....
Nynäshamn	28,000	....	....
BP Raffinaderi–Gothenburg	106,000	....	[2]20,500
Shell Raffinaderi BV–Gothenburg	81,000	....	[2]17,000
Skandinaviska Raffinaderi AB–Brofjorden-Lysekil	200,000	[1]25,000	[4]34,500
Total	**427,500**	**25,000**	**72,000**
SWITZERLAND			
Raffinerie de Cressier SA–Cressier	60,000	....	[2]16,000
Raffinerie du Sud-Ouest SA–Collombey	72,000	....	[2]10,000
Total	**132,000**	**....**	**26,000**
SYRIA			
Banias Refining Co.–Banias	120,000	....	[6]20,000
Homs Refinery Co.–Homs	117,394	....	[2]2,266 [4]9,086
Total	**237,394**	**....**	**31,352**
TAIWAN,			
Chinese Petroleum Corp.–Kaohsiung	425,000	[1]22,600	[2]18,080 [6]18,080
Tao-Yuan	117,500	....	[2]15,800
Total	**542,500**	**22,600**	**51,960**
TANZANIA			
Tanzanian & Italian Petroleum Refining CL–Kigamboni, Dar es Salaam	**17,000**	**....**	**[2]6,700**
THAILAND			
Esso Standard Thailand Ltd.–Sriracha	75,000	....	[5]8,800
Petroleum Authority of Thailand–Bangchak, Bangkok	61,750	....	[2]9,450
Thai Oil CL–Sriracha	83,800	[1]10,200 [2]15,900	[1]2,700 [2]6,600
Total	**220,550**	**26,100**	**27,550**
TRINIDAD			
Trinidad and Tobago Oil CL–Pointe-a-Pierre	116,000	[1]26,000	[4]8,700
Point Fortin	80,000	....	[4]5,700
Total	**246,000**	**26,000**	**14,400**
TUNISIA			
Ste. Tunisienne Industries des Raffinage–Bizerte	**34,000**	**....**	**3,300**
TURKEY			
Anadolu Tasfiyehanesi AS–Mersin	90,000	....	[2]12,000
Turkish Petroleum Refineries Corp.–Aliaga, Izmir[1]	234,120	[1]15,100	[2]12,830
Batman, Siirt	24,350	....	[2]1,300
Izmit	267,325	[1]25,475	[2]20,085
Kirikkale	112,849	....	[2]20,342
Total	**728,644**	**40,575**	**66,557**

Solvent extraction: [1]11,700 b/cd (furfural), 6,700 b/cd (propane deasphalting).

WORLDWIDE REFINING	b/cd Crude capacity	b/cd Catalytic cracking	b/cd Cat reforming
UNITED KINGDOM			
England			
Conoco Ltd.–South Killingholme	130,000	[1]45,000	[2]53,000
Eastham Refinery Ltd.–Eastham, Cheshire	12,000	....	....
Ellesmere Port	22,000	....	....
Esso Petroleum CL–Fawley	300,200	[1]76,500	[2]27,900 [4]22,500
Lindsey Oil Refinery Ltd.–Killingholm, South Humberside	190,000	[1]40,000	[2]33,600
Mobil Oil CL–Coryton, Essex	152,000	[1]52,000	[4]32,000
Phillips Imperial Petroleum Ltd.–Port Clarence	100,000	....	....
Shell U.K. Ltd.–Shell Haven	92,000	....	[6]32,000
Stanlow	262,000	[1]59,000	[2]29,000 [6]27,000
Total	**1,260,200**	**272,500**	**257,000**
Scotland			
BP Refinery Grangemouth Ltd.–Grangemouth	198,500	[1]21,000	[2]32,000
Briggs Oil Ltd.—Dundee	10,240	....	....
Total	**208,740**	**21,000**	**32,000**
Wales			
BP Refinery Llandarcy Ltd.–Llandarcy, Neath	....	....	....
Elf Oil (G.B.) Ltd.–Milford Haven	108,000	[1]32,500	[2]17,800
Gulf Oil-GB–Milford Haven	110,000	[1]28,500	[2]20,500
Pembroke Cracking Co. (65% Texaco, 35% Gulf Oil-GB)—Milford Haven	....	[1]90,000	....
Texaco Ltd.–Pembroke, Dyfed	180,000	....	[6]39,000
Total	**398,000**	**151,000**	**77,300**
Total United Kingdom	**1,866,940**	**444,500**	**366,300**
URUGUAY			
Ancap–La Teja, Montevideo	**33,000**	**[1]4,100**	**[1]2,500**

U.S.S.R.

Government-owned refineries at Achinsk, Angarsk, Baku, Batumi, Chimkent, Drogobych, Fergana, Gorki, Grozny, Guryev, Ishimbai, Khabarovsk, Kherson, Kirishi, Komsomolsk, Krasnovodsk, Kremenchug, Kuibyshev, Lisichansk, Mazheikiai, Moscow, Mozyr, Nadvornaya, Nizhnekamsk, Odessa, Omsk, Orsk, Pavlodar, Perm, Polotsk, Ryazan, Saratov, Syzran, Tuapse, Ufa, Ukhta, Vannovskiy, Volgograd, and Yaroslavl.

WORLDWIDE REFINING	b/cd Crude capacity	b/cd Catalytic cracking	b/cd Cat reforming
Total	**12,300,000**		
VENEZUELA			
Corpoven–El Palito, Carabobo	105,000	[1]41,000	[2]6,000
El Toreño, Barinas	4,800	....	....
Puerto La Cruz, Anzoategui	195,000	[1]12,000	....
San Roque, Anzoategui	5,200	....	....
Lagoven–Judibana, Falcon	571,000	[1]26,500	....
Maraven–Punta Cardon, Falcon	286,000	[1]59,500	....
Total	**1,167,000**	**139,000**	**6,000**
VIRGIN ISLANDS			
Hess Oil Virgin Islands Corp.–St. Croix	545,000	....	[2]125,000
Total	**545,000**	**....**	**125,000**
YEMEN			
Aden Refinery Co.–Little Aden[1]	161,500	....	[1]10,800
Yemen Hunt Oil Co.–Marib	10,000	....	[1]2,500
Total	**171,500**	**....**	**13,300**

Solvent extraction: [1]7,920 b/cd.

WORLDWIDE REFINING	b/cd Crude capacity	b/cd Catalytic cracking	b/cd Cat reforming
YUGOSLAVIA			
Bosanski Brod[1]	112,835	....	[2]7,612 [6]13,500
Lendava	14,600	....	....
Novi Sad	63,000	....	[2]8,200
Pancevo	108,000	[1]20,750	[2]8,800
Rijeka	160,000	[1]21,300	[2]17,500

WORLDWIDE REFINING	b/cd		
	Crude capacity	Catalytic cracking	Cat reforming
Sisak	150,000	[2]10,000	[2]19,000
Zagreb	700	....	....
Total	**609,135**	**52,050**	**74,612**

Solvent extraction: [1]3,300 b/cd (deasphalting).

ZAIRE

Sozir–Muanda	**17,000**	....	**[2]3,500**

ZAMBIA

Indeni Petroleum Refinery CL–Bwana Nkubwa Area, Ndola	**24,500**	....	**[2]5,600**

U.S. refineries

ALABAMA

Company and refinery location	Crude b/cd	Catalytic cracking b/sd	Catalytic reforming b/sd
Coastal Mobile Refining Co.—Mobile Bay	*14,250	...	...
Gamxx Energy Inc.—Theodore	26,500	....	[2]5,000
Hunt Refining Co.—Tuscaloosa	45,000	......	[2]6,000
Louisiana Land & Exploration Co.—Saraland	80,000	......	[2]20,000
Total	**165,750**	......	**31,000**

ALASKA

Company and refinery location	Crude b/cd	Catalytic cracking b/sd	Catalytic reforming b/sd
ARCO Alaska Inc.—Kuparuk	12,000	......	......
Prudhoe Bay	17,500	......	......
Chevron U.S.A. Inc.—Kenai	22,000	......	......
Mapco Alaska Petroleum—North Pole	112,000	......	......
Petro Star Inc.—North Pole	7,200	......	......
Tesoro Petroleum Corp.—Kenai	72,000	......	[4]12,000
Total	**242,700**	......	**12,000**

ARIZONA

Company and refinery location	Crude b/cd	Catalytic cracking b/sd	Catalytic reforming b/sd
Intermountain Refining Cl—Fredonia	5,710	......	......
Sunbelt Refining Co.—Randolph	8,500	....	....
Total	**14,210**	......	....

ARKANSAS

Company and refinery location	Crude b/cd	Catalytic cracking b/sd	Catalytic reforming b/sd
Berry Petroleum Co.—Stevens	*5,700	......	......
Cross Oil & Refining Co. Inc.—Smackover	6,770	......	......
Lion Oil Co.—El Dorado[1]	48,000	[1]18,500	[2]9,000
Total	**60,470**	**18,500**	**9,000**

Solvent extraction: [1]5,500 b/d.

CALIFORNIA

Company and refinery location	Crude b/cd	Catalytic cracking b/sd	Catalytic reforming b/sd
Anchor Refining Co.Inc.—McKittrick	10,000	......	......
Atlantic Richfield Co.—Carson	223,000	[1]82,000	[2]48,000
Chemoil Refining Corp.—Signal Hill	14,200	......	......
Chevron U.S.A. Inc.—El Segundo	254,000	[1]62,000	[2]51,000
Richmond[1]	270,000	[1]63,000	[2]60,000
Conoco Inc.—Santa Maria	9,500	......	......
Edgington Oil Co. Inc.—Long Beach	41,600	......	......
Exxon Co.—Benicia	128,000	[1]65,000	[3]32,000
Fletcher Oil & Refining Co.—Carson	28,750	[1]12,000	[4]5,000
Golden West Refining Co.—Santa Fe Springs	44,000	[1]13,500	[2]19,000
Huntway Refining Co.—Benicia	8,400	......	......
Wilmington	5,500	......	......
Kern Oil & Refining Co.—Bakersfield	20,000	......	[2]3,000
Lunday-Thagard Co.—South Gate	7,000	......	......
Mobil Oil Corp.—Torrance	123,000	[1]63,000	[2]36,000
Pacific Refining Co.—Hercules	*52,250	......	[2]15,000
Paramount Petroleum Corp.—Paramount	*37,050	......	[2]8,500
Powerine Oil Co.—Santa Fe Springs	46,550	[1]12,500	[2]10,000
San Joaquin Refining Cl—Bakersfield	18,000	......	......
Shell Oil Co.—Martinez	140,100	[1]66,000	[3]28,000
Wilmington	133,300	[1]42,000	[2]24,000
Sunland Refining Corp.—Bakersfield	15,000	......	[2]1,500
Ten By, Inc.—Oxnard	4,000	......	......
Texaco Refining & Marketing Inc.—Bakersfield	48,000	......	[2]22,000
Wilmington	*95,000	[1]30,000	[2]39,000
Tosco Corp.—Martinez	131,900	[1]60,000	[2]20,000
			[5]23,000
Ultramar, Inc.—Wilmington	68,000	[1]38,000	[6]14,500
Unocal Corp.—Los Angeles	108,000	[2]47,000	[2]52,000
San Francisco (includes Santa Maria)	118,000	......	[2]34,000
Witco Chemical Corp.,Golden Bear Division—Oildale	10,348	......	......
Total	**2,212,448**	**656,000**	**545,500**

Solvent extraction: [1]50,000 b/sd.

COLORADO

Company and refinery location	Crude b/cd	Catalytic cracking b/sd	Catalytic reforming b/sd
Colorado Refining Co.—Commerce City	28,000	[1]8,500	[2]9,500
Conoco Inc.—Denver	48,000	[1]19,000	[2]10,000
Landmark Petroleum Inc.—Fruita	15,200	....	[2]3,400
Total	**91,200**	**27,500**	**22,900**

DELAWARE

Company and refinery location	Crude b/cd	Catalytic cracking b/sd	Catalytic reforming b/sd
Star Enterprise—Delaware City	140,000	[1]69,000	[2]18,000
			[5]38,000
Total	**140,000**	**69,000**	**56,000**

GEORGIA

Company and refinery location	Crude b/cd	Catalytic cracking b/sd	Catalytic reforming b/sd
Amoco Oil Co.—Savannah	28,000	......	......
Young Refining Corp.—Douglasville	7,500	......	......
Total	**35,500**	......	......

HAWAII

Company and refinery location	Crude b/cd	Catalytic cracking b/sd	Catalytic reforming b/sd
Chevron U.S.A. Inc.—Barber's Point	52,800	[1]20,000	......
Hawaiian Independent Refinery Inc.—Ewa Beach	*90,250	......	[2]13 000
Total	**143,050**	**20,000**	**13,000**

ILLINOIS

Company and refinery location	Crude b/cd	Catalytic cracking b/sd	Catalytic reforming b/sd
Clark Oil & Refining Corp.—Blue Island	66,500	[1]25,000	[2]30,500
Hartford	57,000	[1]26,000	[2]12,000
Indian Refining Co.—Lawrenceville	54,000	[1]34,000	[2]15,000
Marathon Petroleum Co.—Robinson	195,000	[1]43,000	[4]36,500
			[5]41,000
Mobil Oil Corp.—Joliet	180,000	[1]98,000	[2]46,000
Shell Oil Co.—Wood River	274,000	[1]94,000	[2]18,000
			[3]75,000
Uno-Ven Co.—Lemont	147,000	[1]58,000	[2]29,800
Total	**973,500**	**378,000**	**303,800**

INDIANA

Company and refinery location	Crude b/cd	Catalytic cracking b/sd	Catalytic reforming b/sd
Amoco Oil Co.—Whiting	350,000	[1]145,000	[4]85,000
Indiana Farm Bureau Cooperative Association Inc.—Mt. Vernon	20,600	[1]7,000	[2]4,000
Laketon Refining Corp.—Laketon	8,300	......	......
Marathon Petroleum Co.—			

Company and refinery location	Crude b/cd	Catalytic cracking b/sd	Catalytic reforming b/sd
Indianapolis[1]	48,000	[1]19,500	[1]10,500
Total	**426,900**	**171,500**	**99,500**

Solvent extraction: [1]4,500.

KANSAS

Coastal Refining and Marketing Inc.—Augusta	......	......	[4]10,000
El Dorado[1]	*30,400	[1]14,500	[2]4,500
Wichita	*29,925	[1]19,000	[2]6,500
Farmland Industries Inc.—Coffeyville	59,600	[1]25,000	[2]16,000
Phillipsburg	26,400	......	[2]5,300
National Cooperative Refinery Association—McPherson	70,900	[1]20,000	[4]15,000
Texaco Refining & Marketing Inc.—El Dorado	78,000	[1]31,500	[2]18,500
Total Petroleum Inc.—Arkansas City	56,000	[1]19,500	[2]18,000
Total	**351,225**	**129,500**	**93.800**

Solvent extraction: [1]5,500 b/sd.

KENTUCKY

Ashland Petroleum Co.—Catlettsburg	213,400	[1]60,000 §[2]40,000	[2]25,000
Somerset Refinery Inc.—Somerset	5,500	......	[2]1,000
Total	**218,900**	**100,000**	**53,000**

§Reduced crude converter.

LOUISIANA

American International Refinery, Inc.—Lake Charles	*28,500	.....	.....
Atlas Processing Co., Division of Pennzoil—Shreveport	46,200	......	[2]5,000
BP Oil Co.—Belle Chasse	*220,400	[1]92,000	[2]38,000
Calcasieu Refining Co.—Lake Charles	13,500	......	......
Calumet Lubricants Co.—Princeton	4,376	......	......
Canal Refining Co.—Church Point	9,865	......	[1]1,900
CAS Refining Inc.—Mermentau	15,000	.....	.....
Citgo Petroleum Corp.—Lake Charles	320,000	[1]150,000	[2]52,000 [5]54,000
Conoco Inc.—Lake Charles	159,500	[1]42,500	[2]16,000 [5]12,000
Exxon Co.—Baton Rouge[1]	421,000	[1]188,000	[4]90,000
Hill Petroleum Co.—Krotz Springs	56,700	[1]28,000	[2]12,000
St. Rose	28,300	......	......
Kerr-McGee Refining Corp.—Cotton Valley	7,800	......	......
Marathon Petroleum Co.—Garyville[4]	255,000	[1]90,000	[5]45,000
Mobil Oil Corp.—Chalmette	160,000	[1]58,000	[2]28,000 [4]19,000
Murphy Oil USA Inc.—Meraux[2]	97,000	[1]35,000	[6]23,000
Placid Refining Co.—Port Allen[3]	47,000	[1]19,000	[2]10,000
Shell Oil Co.—Norco	215,000	......	[2]16,000 [3-4]38,000
Star Enterprise—Convent	225,000	[1]85,000	[2]40,000
Total	**2,330,141**	**787,500**	**499,900**

Solvent extraction: [1]6,900 b/sd. [2]12,000 b/sd. [3]6,000 b/sd. [4]30,000 b/sd.

MICHIGAN

Crystal Refining Co.—Carson City	4,000	......	......
Lakeside Refining Co.—Kalamazoo	5,600	......	[1]1,000
Marathon Petroleum Co.—Detroit	68,500	[1]27,000	[1]18,500
Total Petroleum Inc.—Alma	45,600	[1]19,500	[2]14,000
Total	**123,700**	**46,500**	**33,500**

Company and refinery location	Crude b/cd	Catalytic cracking b/sd	Catalytic reforming b/sd

MINNESOTA

Ashland Petroleum Co.—St. Paul Park	67,100	[1]23,000	[2]23,500
Koch Refining Co.—Rosemount	*218,500	[1]55,000	[6]26,000 [2]6,000
Total	**285,600**	**78,000**	**55,500**

MISSISSIPPI

Amerada-Hess Corp.—Purvis	30,000	[2]16,000	[2]5,800
Chevron U.S.A. Inc.—Pascagoula	295,000	[1]64,000	[2]90,000
Ergon Refining Inc.—Vicksburg	16,800	......	......
Southland Oil Co.—Lumberton	5,800	......	......
Sandersville	11,000	......	......
Total	**358,600**	**80,000**	**95,800**

MONTANA

Cenex—Laurel[1]	40,400	[1]12,000	[2]12,000
Conoco Inc.—Billings[2]	49,500	[1]19,000	[2]14,700
Exxon Co.—Billings	42,000	[1]21,000	[1]10,000
Montana Refining Co.—Great Falls	6,700	[1]2,400	[2]1,000
Total	**138,600**	**54,400**	**37,700**

Solvent extraction: [1]4,000 b/sd. [2]7,500 b/sd (PDA).

NEVADA

Petro Source Refining Partners—Tonopah	4,500	......	......

NEW JERSEY

Amerada-Hess Corp.—Port Reading	......	[1]50,000	......
Chevron U.S.A. Inc.—Perth Amboy	80,000	......	......
Coastal Eagle Point Oil Co.—Westville	*109,250	[1]50,000	[2]27,000
Exxon Co.—Linden	130,000	[1]120,000	[2]28,000
Mobil Oil Corp.—Paulsboro[1]	100,000	[1]36,000	[2]23,500
Seaview Petroleum Co. L.P.—Thorofare	75,000	.....	.....
Total	**494,250**	**256,000**	**78,500**

Solvent extraction: [1]9,500 b/sd.
* Distallation

NEW MEXICO

Bloomfield Refining Co.—Bloomfield	16,800	[1]6,000	[2]4,000
Giant Industries Inc.—Gallup	20,000	[1]7,800	[2]6,800
Navajo Refining Co.—Artesia	*38,000	[1]20,000	[2]8,000
Thriftway Marketing Corp.—Farmington	2,500	......	[2]500
Total	**77,300**	**33,800**	**19,000**

NEW YORK

Cibro Petroleum Products Co.—Albany	*39,900	......	......

NORTH DAKOTA

Amoco Oil Co.—Mandan	58,000	[1]26,000	[2]12,100
Total	**58,000**	**26,000**	**12,100**

OHIO

Ashland Petroleum Co.—Canton	66,000	[1]25,000	[5]20,000
BP Oil Co.—Lima	*142,500	[1]34,000	[4]55,000
Toledo	*120,650	[1]55,000	[3]23,000 [4]19,000
Sun Refining & Maketing Co.—Toledo[1]	125,000	[1]60,000	[2]45,600
Total	**454,150**	**174,000**	**162,600**

Solvent extraction: [1]9,000 b/sd.

OKLAHOMA

Company and refinery location	Crude b/cd	Catalytic cracking b/sd	Catalytic reforming b/sd
Barrett Refining Corp.—Thomas	11,000	......	......
Conoco Inc.—Ponca City	140,000	[1]53,000	[2]36,000
Cyril Petrochemical Corp.—Cyril	12,500	......	......
Kerr-McGee Refining Corp.—Wynnewood[1]	43,000	[1]20,000	[5]12,500
Sinclair Oil Corp.—Tulsa	50,000	[1]18,000	[1]12,000
Sun Refining & Marketing Co.—Tulsa[2]	85,000	[1]30,000	[2]24,000
Total Petroleum Inc.—Ardmore	68,000	[1]25,000	[6]17,000
Total	**409,500**	**146,000**	**101,500**

Solvent extraction: [1]5,000 b/sd. [2]5,800 b/sd.

OREGON

Company and refinery location	Crude b/cd	Catalytic cracking b/sd	Catalytic reforming b/sd
Chevron U.S.A. Inc.—Portland	.....	.....	.....

PENNSYLVANIA

Company and refinery location	Crude b/cd	Catalytic cracking b/sd	Catalytic reforming b/sd
BP Oil Co.—Marcus Hook	*171,000	[1]50,000	[6]48,000
Chevron U.S.A. Inc.—Philadelphia	175,000	[1]62,000	[2]34,000
Pennzoil Products Co.—Rouseville	15,700	......	[2]5,820
Sun Refining & Marketing Co.—			
Marcus Hook	170,000	[1]87,000	[2]39,600
Philadelphia	125,000	[1]29,000	[2]50,000
United Refining Co.—Warren	*64,600	[1]22,000	[2]16,000
Witco Chemical Co.—Bradford	10,000	......	[2]1,650
Total	**731,300**	**250,000**	**195,070**

Solvent extraction: [1]730 b/sd

TENNESSEE

Company and refinery location	Crude b/cd	Catalytic cracking b/sd	Catalytic reforming b/sd
Mapco Petroleum Inc.—Memphis	60,000	[1]30,000	[2]10,000
Total	**60,000**	**30,000**	**10,000**

TEXAS

Company and refinery location	Crude b/cd	Catalytic cracking b/sd	Catalytic reforming b/sd
Amoco Oil Co.—Texas City	433,000	[1]200,000	[2]160,000
Champlin Refining & Chemicals, Inc.—Corpus Christi	130,000	[1]70,000	[5]52,000
Chevron U.S.A. Inc.—El Paso	66,000	[1]22,000	[2]25,000
Port Arthur	315,900	[1]110,000	[2]23,000 [4]44,100
Coastal Refining & Marketing Inc.—Corpus Christi	*90,250	[1]18,500	[2]11,000 [6]17,500
Crown Central Petroleum Corp.—Houston	100,000	[1]56,000	[2]14,000 [5]22,000
Diamond Shamrock Corp.—Sunray[1]	111,000	[1]45,000	[2]15,000 [5]25,000
Three Rivers[2]	53,000	[1]20,000	[2]11,000
El Paso Refining Co. Ltd.—El Paso	26,000	[1]10,800	[2]7,400
Exxon Co. U.S.A.—Baytown[3]	426,000	[1]180,000	[3]60,000 [4]63,000
Fina Oil & Chemical Co.—Big Spring[4]	55,000	[1]22,000	[2]20,000
Port Arthur[5]	110,000	[1]36,000	[5]34,000
Hill Petroleum Co.—Houston[6]	67,000	[1]61,000	[2]13,500
Texas City	123,500	[1]50,000	[2]11,000 [6]12,000
Howell Hydrocarbons Inc.—San Antonio	2,900	......	[1]1,200
Koch Refining Co.—Corpus Christi	125,000	[1]40,000	[3]15,000 [6]33,500
LaGloria Oil & Gas Co.—Tyler	49,500	[1]17,000	[2]4,000 [5]11,700
Leal Petroleum Corp.—Nixon	12,000	......	......
Liquid Energy Corp.—Bridgeport	10,000	......	......
Lyondell Petrochemical Co.—Houston[7]	265,000	[1]90,000	[2]110,000
Marathon Petroleum Co.—Texas City	69,500	[1]38,000	[1]10,500
Mobil Oil Corp.—Beaumont	275,000	[1]102,000	[2]57,000 [5]46,000
Phillips 66 Co.—Borger	105,000	[1]60,000	[2]26,000
Sweeny	175,000	[1]87,000	[2]36,000
Pride Refining Inc.—Abilene	45,500	......	......
Shell Oil Co.—Deer Park	215,900	[1]65,000	[2]20,000 [4]43,000
Odessa	28,600	[1]10,500	[2]10,000
Southwestern Refining Co., Inc.—Corpus Christi	104,000	[1]50,000	[2]30,000
Star Enterprise—Port Arthur	250,000	[1]110,000	[5]46,000
Trifinery—Corpus Christi	18,000	......	......
Valero Refining Co.—Corpus Christi	25,000	†[2]65,000	......
Total	**3,882,550**	**1,635,800**	**1,140,400**

Solvent extraction: [1]15,000 b/sd. [2]6,000 b/sd. [3]53,000 b/sd. [4]10,000 b/sd [5]18,000 b/sd. [6]17,000 b/sd. [7]6,000 b/sd.
†Heavy oil cracker.

UTAH

Company and refinery location	Crude b/cd	Catalytic cracking b/sd	Catalytic reforming b/sd
Amoco Oil Co.—Salt Lake City	40,000	[1]18,000	[4]7,600
Big West Oil Co.—Salt Lake City	24,000	[2]5,000	[2]5,000
Chevron U.S.A.—Salt Lake City	45,000	[1]11,000 [2]7,000	[2]7,500
Crysen Refining Inc.—Woods Cross	12,500	......	[2]3,000
Pennzoil Products Co.—Roosevelt	8,000	[1]6,000	[2]2,000
Phillips 66 Co.—Woods Cross[1]	25,000	[2]8,400	[2]6,000
Total	**154,500**	**55,400**	**31,100**

Solvent extraction: [1]5,000 b/sd.

VIRGINIA

Company and refinery location	Crude b/cd	Catalytic cracking b/sd	Catalytic reforming b/sd
Amoco Oil Co.—Yorktown	53,000	[1]27,500	[4]10,200
Total	**53,000**	**27,500**	**10,200**

WASHINGTON

Company and refinery location	Crude b/cd	Catalytic cracking b/sd	Catalytic reforming b/sd
Atlantic Richfield Co.—Ferndale	167,000	......	[2]56,000
BP Oil Co.—Ferndale	*90,250	[2]28,500	[4]16,500
Chevron U.S.A. Inc.—Seattle	.....	......	......
Shell Oil Co.—Anacortes	89,300	[1]42,000	[3]26,000
Sound Refining Inc.—Tacoma	11,900	......	......
Texaco Refining & Marketing Inc.—Anacortes[1]	130,000	[1]48,000	[1]8,000 [2]16,000
U.S. Oil & Refining Co.—Tacoma	*32,775	......	[2]6,000
Total	**521,225**	**118,500**	**128,500**

Solvent extraction: [1]4,500 b/sd.

WEST VIRGINIA

Company and refinery location	Crude b/cd	Catalytic cracking b/sd	Catalytic reforming b/sd
Phoenix Refining Co.—St. Mary's[1]	19,180	......	[1]1,500
Quaker State Oil Refining Corp.—Newell	10,500	......	[2]3,400
Total	**29,680**	......	**4,900**

Solvent extraction: [1]1,000 b/sd.

WISCONSIN

Company and refinery location	Crude b/cd	Catalytic cracking b/sd	Catalytic reforming b/sd
Murphy Oil USA Inc.—Superior	**32,000**	**[1]11,000**	**[2]8,000**

WYOMING

Company and refinery location	Crude b/cd	Catalytic cracking b/sd	Catalytic reforming b/sd
Amoco Oil Co.—Casper	40,000	[1]13,500	[4]7,100
Frontier Oil & Refining Co.—Cheyenne	*36,100	[1]11,500	[2]6,600
Little America Refining Co.—Casper	22,000	[1]14,000	[3]6,000
Sinclair Oil Corp.—Sinclair	54,000	[1]21,000	[2]14,500
Wyoming Refining Co.—Newcastle	12,500	[2]4,000	[1]2,750
Total	**164,600**	**64,000**	**36,950**

UNITED STATES

Survey of operating refineries in the U.S. (state capacities as of January 1, 1991)

			b/sd	
State	No. plants	Crude capacity b/cd	Cat cracking Fresh feed	Cat reforming
Alabama	4	165,750	......	31,000
Alaska	6	242,700	......	12,000
Arizona	2	14,210	......	.....
Arkansas	3	60,470	18,500	9,000
California	30	2,212,448	656,000	545,500
Colorado	3	91,200	27,500	22,900
Delaware	1	140,000	69,000	56,000
Georgia	2	35,500	......	......
Hawaii	2	143,050	20,000	13,000
Illinois	7	973,500	378,000	303,800
Indiana	4	426,900	171,500	99,500
Kansas	8	351,225	129,500	93,800
Kentucky	2	218,900	100,000	53,000
Louisiana	19	2,330,141	787,500	499,900
Michigan	4	123,700	46,500	33,500
Minnesota	2	285,600	78,000	55,500
Mississippi	5	358,600	80,000	95,800
Montana	4	138,600	54,400	37,700
Nevada	1	4,500	......	......
New Jersey	6	494,250	256,000	78,500
New Mexico	4	77,300	33,800	19,800
New York	1	39,900	......	......
North Dakota	1	58,000	26,000	12,100
Ohio	4	454,150	174,000	162,600
Oklahoma	7	409,500	146,000	101,500
Oregon	1	.....	......	......
Pennsylvania	7	731,300	250,000	195,070
Tennessee	1	60,000	30,000	10,000
Texas	31	3,882,550	1,635,800	1,140,400
Utah	6	154,500	55,400	31,100
Virginia	1	53,000	27,500	10,200
Washington	7	521,225	118,500	128,500
West Virginia	2	29,680	......	4,900
Wisconsin	1	32,000	11,000	8,000
Wyoming	5	164,600	64,000	36,950
Total	**194**	**15,478,949**	**5,444,400**	**3,901,520**

Refinery throughput

	1980	1981	1982	1983	1984	1985	1986	1987	1988	1989
	(Thousand barrels per calendar day)									
U.S.	13,520	12,470	11,775	11,685	12,045	12,005	12,715	12,855	13,445	13,555
Canada	1,915	1,780	1,520	1,455	1,460	1,430	1,395	1,460	1,535	1,550
Latin America	6,585	6,700	6,205	5,955	5,845	5,585	5,615	5,665	5,590	5,825
Western Europe	12,330	10,970	10,075	9,710	9,790	9,490	10,060	9,960	10,310	10,340
U.S.S.R & Eastern Europe	11,735	12,620	12,720	12,710	12,470	12,185	12,440	12,455	12,485	12,370
Middle East	2,445	2,205	2,245	2,515	2,665	2,795	2,950	2,970	3,140	3,355
Africa	1,460	1,525	1,735	1,920	1,975	2,015	2,095	2,170	2,200	2,175
China	1,430	1,395	1,520	1,600	1,765	1,785	1,865	1,950	2,035	2,150
Japan	4,015	3,630	3,360	3,255	3,355	3,120	2,990	2,910	2,990	3,175
South Asia	705	795	840	880	885	1,020	1,120	1,150	1,160	1,215
Other Asia	2,400	2,510	2,365	2,410	2,485	2,685	2,800	2,785	2,915	3,090
Australasia	640	655	625	605	615	580	580	645	680	695
Total world	**59,180**	**57,255**	**54,985**	**54,700**	**55,355**	**54,695**	**56,625**	**56,975**	**58,485**	**59,495**
Of which OECD & LDCs*	45,860	43,085	40,590	40,230	40,960	40,555	42,150	42,395	43,790	44,705

*Organisation for Economic Cooperation and Development and lesser developed countries
Source: British Petroleum plc

Historical reserve data (billion bbl oil)

	1960	1970	1975	1980	1985	1988	1989	1990	1991
Asia-Pacific									
Australia	—	2.0	1.7	2.4	1.4	1.7	1.7	1.7	1.6
Brunei	—	1.0	2.0	1.7	1.4	1.4	1.4	1.4	1.4
India	—	—	—	2.5	3.5	4.3	6.4	7.5	7.9
Indonesia	9.5	10.0	14.0	9.5	8.6	8.4	8.2	8.2	11.0
Malaysia	—	—	2.5	3.0	3.0	2.9	2.9	3.0	2.9
Europe									
Norway	—	1.0	7.0	5.5	8.3	14.8	10.4	11.5	7.6
United Kingdom	—	1.0	16.0	14.8	13.6	5.2	5.2	4.2	3.8
Middle East									
Abu Dhabi	—	11.8	29.5	29.0	30.5	92.2	92.2	92.2	92.2
Divided Zone	6.0	25.7	6.4	6.0	5.4	5.2	5.2	5.2	5.0
Dubai	—	—	1.0	1.4	1.4	4.0	4.0	4.0	4.0
Iran	35.0	70.0	64.5	57.5	48.5	92.8	92.8	92.8	92.9
Iraq	27.0	32.0	34.3	30.0	44.5	100.0	100.0	100.0	100.0
Kuwait	62.0	67.1	68.0	64.9	90.0	91.9	91.9	94.5	94.5
Oman	—	—	5.0	2.3	3.5	4.0	4.0	4.2	4.3
Qatar	2.5	3.5	5.8	3.6	3.4	3.2	3.1	4.5	4.5
Saudi Arabia	50.0	128.5	148.6	165.0	169.0	166.9	169.9	254.9	257.5
Syria	1.0	1.0	1.0	1.3	1.4	1.7	1.7	1.7	1.7
Yemen	—	—	—	—	—	—	—	3.0	4.0
Africa									
Algeria	5.2	7.0	7.4	8.2	9.0	8.5	8.4	9.2	9.2
Angola-Cabinda	—	—	1.3	1.2	1.8	1.1	2.0	2.0	2.1
Egypt	—	4.5	3.9	2.9	3.2	4.3	4.3	4.5	4.5
Gabon	—	—	—	—	—	0.6	0.7	0.7	0.7
Libya	2.0	29.2	26.0	23.0	21.1	21.0	22.0	22.8	22.8
Nigeria	—	9.3	20.2	16.7	16.7	16.0	16.0	16.0	17.1
Tunisia	—	—	1.0	1.7	1.5	1.8	1.8	1.8	1.7
Western Hemisphere									
Argentina	2.2	4.5	2.5	2.5	2.3	2.3	2.3	2.3	2.3
Brazil	—	—	—	1.3	1.9	2.3	2.5	2.8	2.8
Canada	—	10.7	7.1	6.4	7.1	6.8	6.8	6.1	5.8
Colombia	—	1.7	1.7	1.0	0.624	1.6	2.0	2.0	2.0
Ecuador	—	—	2.5	1.1	1.4	1.6	1.4	1.5	1.4
Mexico	2.3	3.2	9.5	44.0	48.6	48.6	54.1	56.4	51.9
Venezuela	18.5	14.0	17.7	17.9	25.8	56.3	58.0	58.5	59.0
U.S.A.	33.5	37.0	33.0	26.4	27.3	25.3	26.5	25.9	26.2
Subtotal	**268.5**	**511.4**	**555.7**	**562.2**	**614.6**	**808.1**	**823.6**	**917.5**	**916.3**
U.S.S.R.	33.5	77.0	80.4	63.0	63.0	59.0	58.5	24.0	57.0
China	—	—	—	—	19.1	18.4	23.6	24.0	24.0
Other	—	—	—	—	—	1.8	1.7	1.7	1.8
Total world	**302.0**	**611.4**	**658.7**	**648.5**	**698.7**	**887.3**	**907.4**	**1,001.6**	**999.1**

Gas pipeline construction leads world activity

WORLDWIDE PIPELINE CONSTRUCTION ACTIVITY IN 1990 was steady and promised to remain that way the next few years.

Growth of gas pipeline systems was especially strong.

This trend toward more gas pipeline construction continued a pattern evident for several years.

As a clean burning fuel, gas stands to be the big winner as the world searches for fuels that are more environmentally acceptable.

Construction plans, estimated costs

In the U.S., gas pipeline projects in several major areas started up or were due to get under way by yearend 1991. The effect was to clarify the gas transportation and supply pictures for California and areas along the western slopes of the Rocky Mountains and for Oklahoma's Arkoma basin, Florida, and the Northeast.

In Canada, a major gas system to serve Vancouver Island is completing a 2 year installation program. The project had been on the books for more than 30 years. TransCanada PipeLines Ltd. embarked on its major expansion program to move more western Canadian gas east and into U.S. markets.

In Europe, gas holds the promise of reversing much of the environmental harm caused by the burning of high sulfur coal and fuel oil in countries of the former Eastern Bloc. Germany is making by far the more rapid progress as it began plans this year to extend gas transportation and distribution systems into the states of the former East Germany.

In addition, plans for another gas pipeline across the Mediterranean Sea moved ahead in 1991.

Reports to Oil & Gas Journal earlier this year showed pipeline operators planned to lay more than 43,000 miles of crude oil, natural gas, and petroleum products line in 1991 and later.

Those reports indicated that 13,860 miles of line either were being laid as the year began or were part of projects that will begin this year, all to be completed by yearend 1991.

Investment in U.S. liquids pipelines

	Company and investment, $						
	A	B	C	D	E	Total, $	%
CRUDE PIPELINES INVESTMENT BY FIVE COMPANIES							
Land	2,153,078	814,497	292,759	1,029,353	1,236,081	5,525,768	0.32
Right-of-way	12,288,388	1,006,210	316,392	16,578,568	15,997,228	56,186,786	2.64
Line pipe	138,203,476	25,703,218	7,797,471	98,166,788	160,965,781	430,836,734	24.65
Line pipe fittings	10,387,524	955,700	1,386,293	18,173,126	29,552,566	60,455,209	3.46
Pipeline construction	204,045,722	27,837,621	10,931,879	223,969,191	236,543,625	703,328,038	40.23
Buildings	24,171,592	5,013,673	2,517,063	14,446,340	11,470,520	57,619,188	3.30
Boilers	—	—	—	—	—	—	
Pumping equipment	24,646,028	5,524,747	2,414,882	17,621,540	48,174,143	98,381,340	5.63
Machine tools and machinery	—	—	—	33,938	−9,742	24,196	0.00
Other station equipment	96,402,176	22,635,571	4,602,358	48,121,742	36,323,807	208,085,654	11.90
Oil tanks	14,381,418	6,079,983	5,678,530	17,132,528	28,805,137	72,077,596	4.12
Delivery facilities	—	3,973	5,382,864	1,572,342	6,849,372	13,808,551	0.79
Communications systems	1,015,203	3,278,416	71,545	11,853,339	3,757,003	19,975,506	1.14
Office furniture and equipment	3,145,205	295,563	255,012	2,830,149	767,911	7,293,840	0.42
Vehicles and other work equip.	9,934,692	1,078,032	518,113	6,676,245	416,984	18,624,066	1.07
Other property	—	1,399,696	—	—	4,432,008	5,831,704	0.33
Total	**540,774,502**	**101,626,900**	**42,165,161**	**478,205,189**	**585,282,424**	**1,748,054,176**	**100.00**
PRODUCT PIPELINES INVESTMENT BY FIVE COMPANIES							
Land	4,535,405	1,763,961	572,137	1,073,091	3,247,187	11,191,780	0.38
Right-of-way	29,674,813	10,829,964	16,907,192	8,777,681	6,839,606	73,029,256	2.48
Line pipe	345,579,941	67,590,791	99,942,839	87,385,038	98,402,711	698,901,320	23.76
Line pipe fittings	72,723,899	12,899,770	14,370,980	1,743,152	22,323,267	124,061,268	4.22
Pipeline construction	584,068,773	109,254,525	184,761,177	102,011,453	153,971,129	1,134,067,057	38.55
Buildings	24,001,307	4,101,502	4,749,308	10,994,655	17,091,775	60,938,547	2.07
Boilers	—	—	—	—	—	—	
Pumping equipment	45,177,720	6,182,370	28,552,138	28,849,924	20,176,729	128,938,881	4.38
Machine tools and machinery	—	—	—	—	441,510	441,510	0.02
Other station equipment	122,325,732	21,791,408	34,910,983	25,585,067	126,711,226	331,324,416	11.26
Oil tanks	48,938,264	17,525,411	9,065,619	20,147,096	66,656,498	162,332,888	5.52
Delivery facilities	—	—	8,729,825	10,871,129	50,835,414	70,436,368	2.39
Communications systems	1,700,822	644,086	2,366,238	9,175,498	—	13,886,644	0.47
Office furniture and equipment	11,634,736	2,538,234	3,095,206	652,793	1,104,306	19,025,275	0.65
Vehicles and other work equip.	6,148,086	1,930,413	8,668,353	2,594,054	2,655,948	21,996,854	0.75
Other property	73,352,479	—	18,092,213	—	—	91,444,692	3.11
Total	**1,369,861,977**	**257,052,635**	**434,784,208**	**309,860,631**	**570,457,305**	**2,942,016,756**	***100.00**

* Source: U.S. FERC Form 6, Annual Report of Oil Pipeline Companies, Dec. 31, 1989.

U.S. natural gas pipeline transmission expenses*

	Expenses, $		Cost/mile, $		Cost/MMcf sold, $	
	1987-majors†	1988-majors§	1987-majors†	1988-majors§	1987-majors†	1988-majors§
Operation expenses						
Supervision and engineering	151,679,238	166,584,029	610.48	661.37	23.45	26.16
System control and load dispatching	26,858,420	29,284,519	108.10	116.26	4.15	4.60
Communication system expenses	29,310,758	30,224,686	117.97	120.00	4.53	4.75
Compressor station labor and expenses	251,651,867	269,976,844	1,012.85	1,071.86	38.90	42.39
Gas for compressor station fuel	367,406,730	375,892,286	1,478.75	1,492.36	56.80	59.02
Other fuel and power for compressor stations	63,842,107	65,481,393	256.95	259.97	9.87	10.28
Mains	168,358,688	182,166,091	677.61	723.23	26.03	28.60
Measuring and regulating station expenses	61,623,174	61,872,085	248.02	245.64	9.53	9.72
Transmission and compression of gas by others	1,049,122,569	936,299,992	4,222.53	3,717.28	162.18	147.02
Other transmission expenses	38,278,436	40,409,766	154.06	160.43	5.92	6.35
Rents	18,421,763	19,796,436	74.14	78.60	2.85	3.11
Total operation expenses	**2,226,553,750**	**2,177,988,127**	**8,961.49**	**8,657.00**	**344.19**	**341.98**
Maintenance expenses						
Supervision and engineering	34,596,228	31,519,887	139.24	125.14	5.35	4.95
Structures and improvements	21,181,592	22,517,885	85.25	89.40	3.27	3.54
Mains	91,003,249	109,462,229	366.27	434.58	14.07	17.19
Compressor station equipment	197,326,728	218,175,493	749.21	866.20	30.50	34.26
Measuring and regulating station equipment	12,117,702	13,202,645	48.77	52.42	1.87	2.07
Communication equipment	12,077,950	11,906,439	48.61	47.27	1.87	1.87
Other equipment	3,259,046	4,036,815	13.12	16.03	0.50	0.63
Total maintenance expenses	**371,562,495**	**410,821,393**	**1,495.47**	**1,631.03**	**57.44**	**64.51**
Total transmission expenses	**$2,598,116,245**	**2,588,809,520**	**10,456.96**	**10,278.03**	**401.63**	**406.49**
Total miles of transmission pipeline	**248,458**	**251,878**				
Total natural gas sold, MMcf	**6,468,964**	**6,368,682**				

* U.S. interstate pipelines for calendar years 1987 & 1988. † 43 of 126 companies filing Form 2's or 2A's with the U.S. FERC for 1982; majors are companies whose combined gas sold for resale and gas transported or stored for a fee exceed 50 bcf (at 14.7 psi; 60° F.) in each of the 3 previous calendar years. §46 of 135 companies filing Form 2 and 2A with the U.S. FERC for 1988; majors defined in previous note and in U.S. FERC Accounting and Reporting Requirements for Natural Gas Companies, para. 20-011, effective Feb. 2, 1985, beginning with the 1984 reporting year (OGJ, Nov. 25, 1985, p. 80).

Source: Statistics of Interstate Natural Gas Pipeline Companies—1987 & 1988, U.S. Department of Energy.

(NGPL) began service on its $51 million Arkoma basin pipeline in southern Oklahoma.

Farther south, construction was expected to begin by midyear 1991 on a $230 million onshore and offshore pipeline system to transport as much as 1.2 bcfd of gas from Mobile Bay off Alabama to interstate markets.

The Alabama system is a consolidation of competing plans of six interstate pipeline companies. The companies sought FERC approval in 1991 to proceed with a compromise plan.

Parties to the FERC filings were ANR Pipeline Co., Florida Gas Transmission Co., Southern Natural Gas Co., Tennessee Gas Pipeline Co., Texas Eastern Transmission Corp., and Transcontinental Gas Pipeline Corp.

ANR, Southern, Tennessee, Texas Eastern, and TGPL are jointly to own the onshore Mobile Bay pipeline. Florida Gas will lease capacity.

Onshore facilities include TGPL's existing 30 in., 123 mile line from the gas processing plant in Mobile County, Ala., owned by Mobil Exploration & Producing U.S. Inc. to an interconnect with TPGL's mainline near Butler, Ala.

The system is to connect near Citronelle, Ala., with Florida Gas' mainline, where ANR, Southern, and Tennessee agreed to lease capacity to move gas on Florida Gas to their mainline systems.

Texas Eastern is to lease capacity from TPGL to move gas from the interconnect at Butler to its mainline.

Primary project constructor of the $150 million onshore segment of the project, SNG will lay loops and add compression to increase capacity to 1.2 bcfd from 300 MMcfd. It also will lay lines connecting existing onshore facilities with new facilities offshore.

Florida Gas, Southern, Tennessee, Texas Eastern, and TGPL are jointly to construct and own a proposed 77 mile, 600 MMcfd offshore pipeline in Mobile Bay, extending from Main Pass Block 252 to Shell Offshore Inc.'s gas plant being built onshore near Mobil's plant.

The offshore system is to consist of a 30 in. line extending 27 miles from shore to a platform on Mobile Block 955 and a 26 in. line running 50 miles from Mobile 955 to Main Pass 252.

TGPL agreed to build the $80 million offshore system, Florida Gas to operate it.

Vancouver Island, Arctic projects

After more than 30 years of planning, a gas pipeline now connects the Canadian mainland to Vancouver Island, B.C.

Westcoast Energy Inc., Vancouver, B.C., and Alberta Energy Co., Edmonton, Alta., expect to start gas deliveries

U.S. interstate pipeline mileage

Year	Miles Gas	Liquid	Total
1980	274,248	172,673	446,921
1981	274,634	172,815	447,449
1982	286,999	172,549	459,548
1983	285,204	167,819	453,023
1984	*258,379	173,922	*432,301
1985	*279,395	171,401	*450,796
1986	*281,881	170,014	*451,895
1987	*280,085	167,865	*447,950
1988	*281,381	170,457	*451,838
1989	***273,401**	**168,637**	***442,038**

*Reflects mileage operated as reported under the FERC's classification system for natural gas pipeline companies effective beginning with the 1984 reporting year. Only major gas pipeline companies are required to file mileage.

Source: U.S. FERC Form 6, annual reports for oil-pipeline companies; Forms 2 & 2A, annual reports for natural-gas pipeline companies.

by early fall 1991 through the 366 mile pipeline. The $330 million system will receive gas from a Westcoast line at Coquitlam, B.C.

Contractors completed span adjustments and testing in winter 1990 on the Strait of Georgia crossing to Vancouver Island. Much of the onshore portion runs over mountainous terrain and includes about 250 stream and river crossings.

First deliveries to seven pulp mills and, through local distribution companies (LDCs), to 14 communities along the pipeline's route will amount to about 37 MMcfd. Projections to the end of the first decade of service place deliveries at more than 65 MMcfd.

In Alaska, Yukon Pacific Corp. (YPC) in November 1990 began the first phase of a plan to build an 800 mile pipeline for Alaskan North Slope (ANS) gas and an LNG export facility. Plans call for export of as much as 14 million metric tons/year of LNG.

The Trans-Alaska Gas System (TAGS) would transport gas to Anderson Bay, Alas., for shipment overseas.

Under a contract awarded late in 1990, Bechtel Corp. is designing a gas liquefaction plant and marine terminal to be located 3 miles west of Prudhoe Bay oil storage and loading facilities at Valdez.

YPC budgeted $300 million to design the export facility and pipeline.

When all phases of the $11 billion project to liquify and export ANS gas are complete, YPC's LNG plant will be the largest of its kind.

Scheduled to break ground in 1993 for the $3 billion plant, YPC was trying to sign up customers to take 7 million tons/year of LNG. To ensure the project will be profitable, it must increase export rates within 5 years to 14 million tons/year, nearly twice the export volume of the world's largest existing LNG plant.

Markets in Japan, Korea, and Taiwan, which expect to require an additional 24 million tons/year of LNG by 2000, were prime candidates to take North Slope exports. As planned, TAGS can provide access by 1998 to 37 tcf of proved gas reserves on Alaska's North Slope.

Also in the region, sponsors of the Polar Gas Project planned to apply to Canada's National Energy Board (NEB) for permission to build and operate a large diameter pipeline to transport gas from the Mackenzie Delta on Canada's arctic frontier to markets in southern Canada and the U.S.

Polar Gas sponsors TransCanada, Tenneco Gas, and Panarctic Oils Ltd. propose to lay a 36 in., 1,421 mile, buried line from gas fields on the delta, through the Mackenzie River Valley, to Caroline, Alta.

The Mackenzie Valley Gas Pipeline would move as much as 1.2 bcfd of gas for 20 years after completion.

Mackenzie Delta producers Esso Resources Canada Ltd., Shell Canada Ltd., and Gulf Canada Resources Ltd. hold proved, combined Mackenzie Delta gas reserves of about 10.5 tcf. The Geological Survey of Canada estimates total reserves in the area at 68 tcf.

Europe, Far East gas projects

In late 1990, Den norske stats oljeselskap AS (Statoil) began urging installation by 1995 of Europipe, the third Norwegian gas trunkline linking Troll and Sleipner gas fields in the North Sea with continental Europe.

Initial capacity of the 450 km, 36 in. and 40 in. pipeline would be 12 billion cu m/year. The $1.4 billion system would begin at Statpipe's riser platform in Block 16/11, terminating either in The Netherlands or Germany.

Elsewhere in Europe, Portugal is expected to begin construction in 1991 of a gas pipeline system the government hopes to have on stream in 1995.

The proposed system would link with the European network through the Spanish system. The first stage called for laying of pipe from Setubal, south of Lisbon, to Braga, in northern Portugal near the Spanish border.

Included in the project would be construction of an LNG receiving terminal at Setubal, a trunkline, and distribution lines. When operational, the system would supply gas to about 2 million residential, 80,000-100,000 commercial, and 4,000-5,000 industrial customers.

Also in late 1990, the U.S.S.R. signed a contract with Greece for Soviet crews in 1993 to begin laying a 500 km line that would deliver gas from Izmail on the Soviet-Romanian border, through Romania and Bulgaria, to Thessalonika in northern Greece.

Greece in 1988 signed a 25 year agreement to accept initial Soviet gas deliveries amounting to 35 bcf/year.

In Germany, competition to supply the newly unified country with gas has been steadily heating up.

Ruhrgas AG purchased a 35% interest in Verbundnetz Gas AG, the transmission company for the former East Germany. And Ruhrgas announced plans to construct several pipelines to connect its supply system with the eastern states.

Wintershall AG teamed up with Kombinate Gasanlagen to build the Stegal line. This will be an east-west pipeline from the Czechoslovak border to Heringen near the former boundary between East and West Germany. Initial capacity is set at 71 bcf/year.

This line is to connect with another Wintershall project, the 580 mile Midal north-south line from Tysum on the North Sea to Ludwigshafen, south of Frankfurt.

In another part of Europe, steps toward a second trans-Mediterranean gas pipeline advanced early in 1991.

In February, six companies formed a joint venture to study the feasibility of a 1,250 mile line from Algeria to Spain. If built by 1995-96, the line could supply 105-175 bcf/year of gas to Spain, 35-70 bcf/year to Morocco, and 35 bcf/year to Portugal.

In the Far East, Malaysia's Petroliam Nasional Bhd. (Petronas) was nearing completion of its Peninsula Gas Utilization (PGU) pipeline system.

Initially, the 452 mile, mostly 36 in. PGU line is to transport 750 MMcfd of gas from Malaysia's east coast to a power plant on the west side of the Malaysian peninsula near the capital city of Kuala Lumpur, down the western coast to Johor Bahru in southern Malaysia, and to Singapore by way of a water crossing.

PGU throughput is expandable to 1 bcfd.

PGU project manager Novacorp (Malaysia) Sdn. Bhd. expected to begin testing by midyear 1991 of the PGU segment linking Kerteh on Malaysia's east coast to the west coast.

Pipeline construction in 1991 and beyond*

Area	†4-10 in.	12-20 in.	22-30 in.	Larger than 30 in.	Total
			Miles		
GAS PIPELINES					
U.S.	106	569	1,881	3,515	6,071
Canada	—	22	491	3,487	4,000
Latin America	789	519	519	—	1,827
Asia-Pacific	112	860	441	227	1,640
Western Europe	201	287	258	2,350	3,096
Middle East	—	—	—	880	880
Africa	3	9	17	741	770
Total gas	**1,211**	**2,266**	**3,607**	**11,200**	**18,284**
CRUDE PIPELINES					
U.S.	—	139	122	130	391
Canada	—	—	130	150	280
Latin America	—	271	—	199—	470
Asia-Pacific	338	361	—	—	699
Western Europe	22	137	161	—	320
Middle East	—	—	—	1,340	1,340
Africa	1,096	632	43	23	1,794
Total crude	**1,456**	**1,540**	**456**	**1,842**	**5,294**
PRODUCT PIPELINES					
U.S.	246	45	—	—	291
Canada	—	—	—	—	—
Latin America	688	1,098	—	—	1,786
Asia-Pacific	70	1,337	1,517	—	2,924
Western Europe	525	500	—	—	1,025
Middle East	—	—	—	—	—
Africa	—	34	—	—	34
Total product	**1,529**	**3,014**	**1,517**	—	**6,060**
WORLD TOTALS					
Gas	**1,211**	**2,266**	**3,607**	**11,200**	**18,284**
Crude	**1,456**	**1,540**	**456**	**1,842**	**5,294**
Product	**1,529**	**3,014**	**1,517**	—	**6,060**
Total	**4,196**	**6,820**	**5,580**	**13,042**	**29,638**

* Projects planned to commence in 1991 and be completed in 1992 or later. Includes some probable major gas projects whose installation will begin later than 1991. † Includes some projects of less than 4 in. OD.

By October 1991, it will test the entire system from Kerteh to Johor Bahru.

Novacorp Malaysia, which took over as project manager in December 1986, will operate the system for 2 years after completion. MMC Gas consortium is contractor on the PGU project.

Costs continue to moderate

Construction cost estimates for planned U.S. interstate gas pipeline construction provide one measure of the cost of building a pipeline for any service anywhere in the world.

Regulated U.S. interstate gas pipeline companies report cost estimates to FERC as part of filings to gain approval to add or replace segments in the U.S. The latest available figures for such estimates are current through mid-1990.

For proposed U.S. gas pipeline projects in the most recent 12 month period surveyed, the average onshore construction cost was $830,882/mile, a slight decrease for the 12 month period immediately preceding.

For offshore projects, the more current figure was $834,057/mile, an increase of 13.1% from the period immediately preceding.

Combined land and offshore projects show an average cost of $830,908/mile.

Analyses of the four major categories of pipeline construction costs—material, labor, right-of-way, and miscellaneous—can also reveal trends within each group.

Right-of-way figures include the cost of obtaining right-of-way and of surveying, along with allowance for damages.

Miscellaneous generally includes engineering, supervision, contingencies, allowances for funds used during construction, administration and overhead, and FERC filing fees.

For the 171 projects surveyed for the most recent period, cost per mile data for the four categories are as follows:

- Material—Land, $342,912/mile; offshore, $345,566/mile; total, $342,934/mile.
- Labor—Land, $298,043/mile; offshore, $283,654/mile; total, $297,925/mile.
- Right-of-way and damages—Land, $159,081/mile; offshore, $18,295/mile; total, $159,305/mile.
- Miscellaneous—Land, $30,846/mile; offshore, $18,543/mile; total, $30,744/mile.

Although generalities are difficult to make concerning trends in construction costs, the cost per mile figures within a given diameter category shows that the longer the pipeline, the lower the incremental cost for construction.

Nonetheless, road, highway, and river crossings and marshy or rocky terrain each strongly affects pipeline construction costs.

Material and labor make up almost 78% of the cost of constructing land pipelines and almost 76% of the cost for offshore pipelines.

Compressor station costs make up another major cost element of gas pipelines.

Pipeline construction in 1991*

Area	†4-10 in.	12-20 in.	22-30 in.	Larger than 30 in.	Total
			Miles		
GAS PIPELINES					
U.S.	1,011	1,135	930	1,782	4,858
Canada	764	102	89	564	1,519
Latin America	—	—	—	236	236
Asia-Pacific	122	329	629	485	1,565
Western Europe	236	174	290	436	1,136
Middle East	—	67	93	—	160
Africa	—	22	—	—	22
Total gas	**2,133**	**1,829**	**2,031**	**3,503**	**9,496**
CRUDE PIPELINES					
U.S.	209	159	13	60	441
Canada	—	16	—	—	16
Latin America	37	49	290	—	376
Asia-Pacific	293	210	—	—	503
Western Europe	9	39	47	—	95
Middle East	—	—	—	63	63
Africa	19	84	57	—	160
Total crude	**567**	**557**	**407**	**123**	**1,654**
PRODUCT PIPELINES					
U.S.	388	126	—	—	514
Canada	—	8	—	—	8
Latin America	194	82	37	—	313
Asia-Pacific	22	—	15	—	37
Western Europe	864	175	—	—	1,039
Middle East	—	—	—	—	—
Africa	490	309	—	—	799
Total product	**1,958**	**700**	**52**	—	**2,710**
WORLD TOTALS					
Gas	**2,133**	**1,829**	**2,031**	**3,503**	**9,496**
Crude	**567**	**557**	**407**	**123**	**1,654**
Product	**1,958**	**700**	**52**	—	**2,710**
Total	**4,658**	**3,086**	**2,490**	**3,626**	**13,860**

* Projects under way at the start of 1991 or set to begin and be completed that year. † Includes some projects of less than 4 in. OD.

Costs for new land compressor stations for the most recent period ranged from a low of $667/hp for a 12,600 hp station in Colorado to a high of $4,551/hp for a 1,200 hp station in Massachusetts. Cost per horsepower figures show no particular correlation with compressor station size or location.

After a gas pipeline is laid and compressor stations constructed, operating costs become the next consideration.

As an aid in estimating this element, transmission expenses for interstate gas pipelines for 1987 and 1988, the most recent years for which the FERC has data available, have been included in an accompanying table.

Its data are based on 248,458 miles of pipeline operated and 6.5 tcf of gas sold for 1987 majors and on 251,878 miles of pipeline operated and 6.4 tcf of gas sold for 1988 majors.

- The highest component of transmission operating expenses is transmission and compression of gas by others. For majors in 1987 this component was $4,222/mile or $162/MMcf. For majors in 1988 this component was $/3,717mile or $147/MMcf.
- The second highest cost component of transmission operating expense is gas for compressor station fuel. For majors in 1987 this component was $1,479/mile or $57/MMcf, for majors in 1988 $1,492/mile or $59/MMcf.
- The highest cost component of maintenance expense covers compressor station equipment: for majors in 1987 $794/mile or $30/MMcf, for majors in 1988 $866/mile or $34/MMcf.
- The second highest cost component for maintenance is maintenance of pipelines: for majors in 1987 $366/mile or $14/MMcf, for 1988 majors, $435/mile or $17/MMcf.
- The table indicates that the highest component of transmission expenses for natural gas pipelines is the operation expense: for 1987 majors $8,961/mile or $344/MMcf, for 1988 majors $8,647/mile or $342/MMcf;
- Unit maintenance expenses for 1987 majors were $1,495/mile or $402/MMcf, for 1988 majors $1,631/mile or $406/MMcf.
- During 1987 major natural gas pipeline companies spent slightly more than $2.2 billion for operating expenses and $371.6 million on maintenance. Total spending by 1987 majors for operation and maintenance expenses reached almost $2.6 billion.

Total operation expenses for majors in 1988 fell slightly less than 2.2 billion, a drop of almost $48.6 million (−2.2%). This follows a sharp drop of 14.3% from 1986 to 1987 noted a year earlier.

Total maintenance expenses in 1988 rose to slightly more than $410 million from a 1987 cost of $371 million.

Total transmission expenses showed a slight decline in 1988 to $2.588 billion.

- On a unit basis, the total 1987 transmission expense for majors was $10,457/mile or $402/MMcf, for 1988 $10,278/mile or $407/MMcf of gas sold.

WORLDWIDE GAS PROCESSING

Capacities as of January 1, 1990, and average production

		MMcfd		Production—1,000 gal/day (Average based on the past 12 months)								
Country	No. plants	Gas capacity	Gas through-put	Ethane	Prop.	Isobut.	Process or unsplit butane	LP-gas mix	Raw NGL mix	Debut. nat. gaso.	Other	Total products
United States												
Alabama	7	255.0	200.7	....	164.3	....	129.1	6.4	39.9	93.2	434.7	867.6
Alaska	4	4,073.5	3,946.0	....	2.6	....	....	....	2,356.6	....	....	2,359.2
Arkansas	4	933.0	578.4	0.3	7.5	1.6	6.5	....	48.8	6.0	3.0	73.7
California	34	1,032.7	655.3	....	416.0	36.8	245.6	77.0	331.2	83.2	11.4	1,201.2
Colorado	42	1,101.5	687.8	63.1	248.0	....	98.9	44.4	655.8	57.6	18.3	1,186.1
Florida	2	890.0	755.0	71.1	115.8	22.0	79.0	....	....	70.1	....	358.0
Kansas	25	5,448.1	3,786.1	360.2	937.0	95.5	408.5	47.2	378.2	302.7	1.9	2,531.2
Kentucky	2	71.0	45.6	....	....	....	....	....	117.5	....	....	117.5
Louisiana	80	18,720.5	11,059.8	1,152.6	1,094.5	344.5	361.0	35.5	5,698.3	668.3	320.1	9,674.8
Michigan	31	4,824.1	1,703.9	....	24.6	....	....	61.6	665.1	15.0	38.4	804.7
Mississippi	7	902.2	373.7	....	9.3	....	8.0	....	15.8	9.1	2.3	44.5
Montana	7	27.0	10.6	....	29.6	6.8	5.0	17.7	18.2	11.1	1.0	89.4
Nebraska	1	1.5	0.9	....	....	....	....	....	0.4	....	....	0.4
New Mexico	28	3,176.0	2,210.4	160.4	130.6	11.5	41.9	34.3	4,633.9	44.0	35.3	5,091.9
North Dakota	8	165.0	108.9	....	150.4	....	84.1	....	113.4	23.6	13.2	384.7
Oklahoma	103	4,433.5	2,644.7	782.2	679.3	100.4	259.8	188.4	4,230.5	303.9	220.9	6,765.4
Pennsylvania	2	14.0	8.3	....	4.7	....	3.0	....	....	4.1	....	11.8
Texas	315	16,621.4	10,691.3	3,477.7	3,325.5	563.5	1,544.1	3967.7	15,270.6	2,249.6	1,420.1	28,247.8
Utah	12	537.5	266.9	....	95.6	....	22.8	....	135.1	43.8	1.7	299.0
West Virginia	7	397.0	324.9	235.6	143.7	24.1	44.8	88.2	256.2	....	....	792.6
Wyoming	40	3,488.5	2,687.0	....	236.8	10.8	155.5	73.5	2,518.4	135.1	257.4	3,387.5
Total U.S.	**761**	**67,114.0**	**42,756.2**	**6,303.2**	**7,815.8**	**1,217.5**	**3,497.6**	**1,070.9**	**37,483.9**	**4,120.4**	**2,779.7**	**64,289.0**
Abu Dhabi	5	1,602.0	1,269.0	....	....	....	....	....	....	546.0	....	546.0
Algeria	4	5,335.2	4,268.2	....	....	....	....	632.8	....	....	5,449.2	6,082.0
Argentina	14	1,488.4	1,498.9	687.7	497.2	....	334.8	....	....	319.8	0.8	1,840.3
Australia	5	2,573.0	1,376.0	279.0	441.0	....	249.0	610.3	....	1,058.5	850.0	3,487.8
Austria	1	17.5	13.7	....	....	....	....	26.7	....	28.4	....	55.1
Bahrain	1	168.0	155.0	....	....	....	....	25.6	....	....	....	25.6
Bangladesh	2	240.0	178.0	....	....	....	....	....	....	....	8.2	8.2
Bolivia	2	474.0	177.3	....	1.4	2.5	....	161.7	....	61.5	136.9	364.0
Brazil	11	449.7	433.6	0.9	....	....	....	519.1	209.6	135.3	9.6	874.5
Brunei	2	1,032.0	832.4	....	9.4	....	....	....	50.1	252.1	....	311.6
Canada												
Alberta	473	22,630.2	14,033.4	6,419.9	3,248.3	870.4	814.2	1,214.8	4,160.0	4,123.1	671.4	21,522.1
British Columbia	14	1,780.3	856.5	....	192.5	....	65.9	3.5	....	31.0	....	292.9
Northwest Territories	2	219.9	28.3	....	....	....	....	....	....	....	....	....
Saskatchewan	23	295.4	194.3	....	....	....	....	12.9	104.7	0.3	18.0	135.9
Chile	2	470.0	423.0	....	190.0	....	120.0	....	....	106.0	....	416.0
China, Taiwan	4	270.3	60.3	13.2	26.4	0.8	16.8	....	8.7	....	12.3	78.2
Colombia	6	348.0	218.0	132.8	52.0	....	58.5	43.5	....	70.7	1.1	358.6
Denmark	1	450.0	240.0	....	....	....	....	....	....	....	100.0	100.0
Dominican Republic	1	....	....	....	....	....	....	....	....	....	277.2	277.2
Dubai	1	330.0	330.0	....	....	....	....	....	....	....	650.5	650.5
Ecuador	2	41.0	20.5	....	....	....	....	97.1	....	37.3	....	134.4
Egypt	8	1,320.0	1,188.0	....	....	....	....	691.7	....	....	1,158.5	1,850.2
France	1	570.0	563.0	....	139.0	....	132.0	....	....	270.0	....	541.0
Germany	3	366.0	274.0	....	....	....	....	....	....	....	....	....
Greece	2	39.0	31.2	....	....	....	....	....	72.0	....	....	72.0
Hungary	12	1,097.2	475.3	....	65.7	6.3	70.0	....	367.4	819.2	103.6	1,432.2
Indonesia	10	3,900.5	3,496.2	17.3	345.6	113.4	0.9	51.6	1,462.4	24.0	5.2	2,020.4
Italy	17	7,614.0	1,587.0	....	....	....	....	2.7	8.0	7.5	....	18.2
Kuwait	1	1,815.0	1,452.0	....	1,722.0	....	980.0	....	....	811.8	....	3,513.8
Libya	7	1,851.0	1,227.0	....	....	....	....	37.8	5,577.0	....	551.0	6,165.8
Malaysia	2	282.0	105.0	161.4	23.2	136.3	28.2	....	....	154.1	....	503.2
Mexico	11	4,649.0	3,370.4	12,704.9	....	....	....	....	....	....	9.5	12,714.4
Netherlands	1	350.0	35.0	....	....	....	....	....	....	....	4.2	4.2
New Zealand	6	1,152.0	533.0	....	39.1	....	1.8	134.7	....	18.6	733.7	927.9
Norway	2	950.0	507.0	....	682.0	108.0	256.0	....	200.0	193.0	....	1,439.0
Oman	8	626.0	309.4	....	....	....	....	....	202.0	43.0	....	245.0
Pakistan	7	430.0	187.7	....	....	....	....	48.8	6.1	....	9.1	64.0
Peru	2	70.0	37.0	....	3.4	....	1.0	5.6	28.9	....	4.0	42.9
Qatar	2	579.0	232.0	....	434.6	....	255.5	....	....	173.0	....	863.1
Saudi Arabia	5	4,300.0	....	....	....	....	....	....	....	....	....	....
Sharjah	2	990.0	925.0	....	290.0	....	214.0	....	....	....	1,239.0	1,743.0
Spain	3	428.0	177.0	....	....	....	....	....	....	....	73.0	73.0
Thailand	2	850.0	550.0	....	....	....	....	400.4	8.4	84.0	....	492.8
United Kingdom	9	3,732.0	1,537.0	....	332.0	....	291.0	....	150.0	1,748.5	51.8	2,573.3
Venezuela	14	2,913.0	2,557.0	213.3	197.4	....	113.4	231.3	3,274.6	171.9	....	4,201.9
Yemen	1	400.0	324.0	....	....	....	....	....	120.0	189.0	....	309.0
Total, outside U.S.	**712**	**81,488.6**	**48,286.6**	**20,630.4**	**8,932.2**	**1,237.7**	**4,003.0**	**4,952.6**	**16,009.9**	**11,477.6**	**12,127.8**	**79,371.2**
World Total	**1,473**	**148,602.6**	**91,042.8**	**26,933.6**	**16,748.0**	**2,455.2**	**7,500.6**	**6,023.5**	**53,493.8**	**15,598.0**	**14,907.5**	**143,660.2**